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ABSTRACT

This annotated bibliography is based on a literature search which was commissioned to complement the report on a conference hosted by Dartmouth University (New Hampshire) in October 1988. An introductory essay describes the conference, which brought together 30 educators from a wide variety of institutions for 3 days to reflect on the effectiveness of educational computing, and to use this reflection to help define appropriate future directions for computing technology in higher education. The research studies are listed alphabetically by principal author and the theme or trend from the conference to which it is related is indicated. The 13 themes are Alternative Methods (22 citations); Cognitive Styles and Personality Types (25); Control Issues (9); Future/Effectiveness of Computer-assisted Instruction (7); Human Factors (14); Hypertext/Hypermedia (13); Interactive multi-media (26); Kinds, Styles, Modes of Learning (9); Large Databases and Lab Data (13); Problem-solving-based Learning (20); Research and Evaluations (23); Simulation versus Authentic (11); and Tests and Evaluation Methodology (3). This publication also contains a bibliography of reviews of instructional software selected from scholarly journals within academic disciplines or from anthologies published by academic presses. The reviews are listed alphabetically under the following subjects: biology, chemistry, economics, education, engineering, English, general composition or writing, geology, history, language, mathematics, medicine, philosophy, physics, psychology, and science. Each review meets some or all of the following criteria: (1) identifies needs of the discipline which the software purports to address; (2) describes the use of the software to enhance learning; (3) compares the software to other software in similar areas; and (4) reports on the evaluation of software effectiveness. (DB)

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Beyond Courseware:

A Report and Bibliography prepared for the Alfred P. Sloan Foundation on Computing Technology in Higher Education

Contents:

Introductory remarks and summary.
Selected bibliography of research on computing in higher education.
Selected bibliography of reviews of academic software in scholarly publications.

This report and the bibliographies were prepared by David Bantz, Nancy Millichap Davies, and Harold C. Lyon, Jr. with assistance from Darshon Bhatia, Chris Hyun, Joan Leguard, Nicole Smith and Pat Wykes

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An Appropriate Time for Reflection on Educational Computing

During the 1980's Dartmouth, as well as a number of other colleges and universities, actively pursued the development of "courseware," computer software designed to address specific instructional needs or opportunities identified by individual faculty. Dartmouth's Courseware Development Group worked with many faculty to develop software which promised to present particular topics more effectively, by allowing students to manipulate data or receive immediate feedback, or associate numerical and graphical information. Other faculty developed courseware on their own or in collaboration with students. Some Dartmouth courseware has been commercially distributed. The overall high quality of the Courseware Development Group's Macintosh software was recognized by a unique group award by Apple Computer.

The courseware model applied to the newly popular personal computer seemed in the 1980's a clearly desirable development to many faculty and administrators and to foundations and vendors which effectively fueled the process by funding our proposals. The end of the 1980's has been an appropriate time for a retrospective evaluation of the effectiveness of these efforts as measured against basic institutional goals. It is probably an understatement to say that faculty, administrators, developers, funding agencies and vendors have been surprised at many features of the development of personal computing and courseware: computing power that seemed futuristic a decade ago is a commonplace on faculty and student desks; educational courseware nearly always costs much more than estimated and requires more computing power to run well; a great deal of innovative and powerful applications have been created which hint at fundamental restructuring of curricula; yet computing is integrated into a very small portion of any school's curriculum.

As a major grant from the Sloan Foundation for courseware development at Dartmouth came to an end, Dartmouth hosted a conference intended to provide critical reflection on the effectiveness of educational computing, and to use this reflection to help define appropriate future directions for computing technology in the service of higher education. Thirty educators from a wide variety of institutions met at Dartmouth in October 1988 for three days of presentations and intensive discussion. While there were, of course, no formal joint statements, or even general agreement on themes among the participants, the discussions did suggest that there were some surprisingly pervasive general trends. The discussions also made it clear that there were certain issues and topics which, while unresolved or poorly understood, would be useful for guiding the effective applications of computing or other technology to higher education.

Some of the general tendencies, reinforced by our reading and by presentations at subsequent conferences, are listed below (taken from the conference report to the Sloan Foundation). The issues which appeared to call for further research were the initial topics for a literature search which we commissioned to complement the report on the conference; the results of the literature search are in the form of an annotated bibliography of selected materials. We have also included a selected bibliography of reviews of instructional software from scholarly journals and anthologies from academic presses.

Themes and Trends in Educational Computing

- Presentation of information in "realistic" modes is an important enhancement to its comprehension and manipulation. Thus, realistic color images rather than stick drawings, actual data rather than contrived examples, authentic sounds are all important enhancements to instructional applications.
- Participants agreed that we need to emphasize providing an environment which enables and encourages learning rather than being explicitly didactic in instructional applications. Among other things, this strategy entails control of the pace and choice of topics on the part of users, richness of information which provides the sense of limitless exploration of threads of thought and connections, and the illusion of direct manipulation of the user interface.
- Substantial and challenging educational applications are feasible in virtually all disciplines. Indeed, some of the most exciting applications of computing deal with value theory, music performance on traditional instruments, history, classics and other traditional liberal arts disciplines.
- The availability of new computing and display technologies has enabled high standards for presentation of information; as a consequence, the expectations of users and audiences have dramatically escalated. Command driven line oriented interfaces or crude "computer-looking" displays are not going to be taken as seriously as higher quality presentations.
- "Multimedia" is more than a catch word for fancy presentations. By simultaneously engaging and relating different cognitive modes, high quality sound, careful use of color, and video enhance and contribute to the utility of educational applications.
- Collaborative, long term projects which deal systematically with a large field of inquiry seem to generate more interest than the single-purpose self-contained piece of "courseware."

Literature Survey on Educational Computing

We used the discussions at the Sloan Conference and subsequent discussions with several colleagues to identify areas or topics for which we wanted to find research. Harold Lyon, Jr. helped refine the list and was responsible for the initial selection of papers. The general topic headings under which we agreed to find research are indicated in the annotation for each item in the bibliography at the beginning of the comments.

We have also included a bibliography of reviews of academic software. Serious evaluation of the effectiveness of particular software products is increasingly seen as necessary, by potential users of software who need guidance in selecting software which will be effective in their courses, by developers who need professional recognition and critical evaluation of their efforts, and by administrators and funding agencies who need information on the effectiveness of development efforts they are called upon to evaluate, reward, and fund. More important, extended scholarly reviews which place academic software and its use into a disciplinary context provide the environment in which alternative approaches and methods can be compared, criticized, and improved. Without such critical professional activity, the application of computing technology must continue to be a peripheral or even suspect aspect of professional academic life. With it, we can at least hope to draw on the strengths of the disciplines to realize the potential of educational applications of computing. The reviews in this bibliography have been published in scholarly journals within academic disciplines or in anthologies published by academic presses. Each of them meets at least some of the following desiderata: it identifies needs of the discipline which the software reviewed purports to address; it describes the use of the software to enhance learning and relates that use to experience or theory supporting those learning techniques; it compares the software to other software addressing similar areas; and it reports on the evaluation of the effectiveness of the software in actual use. Few if any of the reviews satisfy all of these desiderata of course, and many of the reviews are in fact self-reports of the development and use of software (these cases are indicated in the bibliography). Nevertheless, we hope the bibliography as a whole provides models for critical scholarly evaluation of academic software. (This bibliography was prepared with additional funding from EDUCOM.)

Beyond Courseware: Solutions, Tools, and Information

We are used to thinking of educational software as addressing a particular 'problem' in teaching the material of a discipline. The software is thus a 'solution' to the problem. This formulation places computing not only at the service of traditional curricular approaches, but squarely within these frameworks. Educational software is designed to fit the constraints of a particular course segment and thus reflect the strengths and weaknesses of existing learning paradigms. We implement these restrictions of scope by demanding, in the design and in the funding requests for software, concrete restricted descriptions of problems which a computer program might plausibly explicitly solve.

One consequence of the focus on solutions to the problems of existing curricular and pedagogical practice is that, even when successful, such applications of computing technology provide greater efficiency at the same—or marginally extended—teaching practices. These 'solutions' are also bound to particular courses, making it difficult to export these solutions to courses at other institutions or courses at different levels.

It is partly in recognition of the limitations of such traditionally conceived courseware that many developers and theorists have focused on the utility of software 'tools.' Rather than relying on a particular didactic model or sequence of presentations, educational software tools are more general and flexible software which allow instructors to adapt or customize the material to suit. The best known of such tools are general productivity software in educational guises (*e.g.*, word processors and spread sheet programs) and 'authoring systems' designed to ease the creation of drills, exercises and presentations in a range of targeted disciplines. Creative and resourceful teachers can and do create effective learning environments with such tools, encouraging, for example, extensive revision and rewriting with the use of word processing software, or creating foreign language drills at just the right level for their students. Yet such tools have not substantially diminished the tendency to produce idiosyncratic solutions to the problems of a particular course.

An important reason for the limited effectiveness of such tools is apparent if we focus on the most ambitious of them. Tools become more flexible by assuming less about the material to be presented on the screen, and thus demanding more work on the part of the 'author' (*i.e.*, the instructor developing materials). Some authoring systems are so complex that they in effect demand programming skills of the author. Some software tools require extensive training of students who are to use the tools. There are complementary dangers in this situation: when the software tools themselves come thus to the foreground, the assumptions, frameworks, and presentational conventions of the tools effectively partially constitute the subject matter. To the extent that an author (*i.e.* instructor) effectively uses or subverts the tool to reflect subject matter specific content and pedagogical method, the result retains the parochial limitations of the older form of courseware.

The concerns above may be summarized by the claim that computing technology, even where providing effective solutions to specific problems, too often stands between learners and the content matter of the discipline (at least for those who have not created the materials). There is an alternative conception. Suppose we follow the lead of a number of recent projects with broad appeal (for example, the Perseus Project, IRIS Intermedia, and Project Jefferson) and focus, not directly on the process of instructing or transferring information, but instead on providing data appropriate for the problem area or discipline. Computing technology, in this model, should facilitate access to information. Of course 'information' is a construct which implies some prior conceptual organization and selection. But this conceptual organization is the business of the disciplines *per se*; it need not be constructed *de novo* in the process of developing educational software.

Access to information can be facilitated by providing means to explore or easily search for specific kinds of information and to manipulate the information in ways which make sense in terms of problems or methods of the discipline. Thus this information-oriented approach also requires software tools, but of quite a different sort from those described earlier. Instead of tools whose functions are based on the construction of new didactic materials, or on manipulation of computer displays and the like, the functions are those which arise from the disciplines themselves. Rather than providing basic mathematical functions on gene sequence data, for example, we should enable calculations of genetic distances; rather than providing a database language or literal string searches on language texts, we should provide intelligent indices and easy access to lexical databases such as dictionaries for readers. The presentation of materials in concise informative formats is also typically well-developed within disciplines. Information-oriented educational software automatically presents material in its appropriate discipline-determined format rather than providing generic 'tools' for presentation.

The value of information-based educational computing will be enhanced if discipline-specific tools operate on a few widely shared formats for data. The development and standardization of such formats would facilitate educational software development greatly, and encourage sharing of the same information (say historical data or electronic texts, or image banks) for quite different purposes. Developers could focus on augmenting existing large (shared) banks of information and producing sharply focused tools appropriate in their disciplines, instead of creating idiosyncratic 'systems' which cannot share information with others.'

A Selected Bibliography of Research on Computing Technology in Higher Education

Abdulla, A. M., J. S. Henke, and L. O. Watkins. "Computer-aided Learning: Experiences, Perspectives and Promises." Journal of the American College of Cardiology 9.3 (1987): 678-683.
Interactive multi-media. The authors describe an authoring system they designed to help faculty at medical schools develop a library of effective computer-based lessons. Features of the system include ease of authoring and the ability to incorporate natural language input by the learner, model complex situations, keep track of 100 performance variables and employ interactive laser video disk technology. They conclude with reflections on the future application and value of computer-aided learning in medical education.

Avner, Elaine, and Allen Avner. "Connecting NovaNET and PLATO to an External Database: The University of Illinois Library Online Catalog." Annual Meeting of the Association for the Development of Computer-Based Instructional Systems. Philadelphia, PA. November 7-10, 1988. 16 pp.
Large Databases and Lab Data. This paper provides the documentation for the program that provides access to the University of Illinois Online Catalog, together with a script to be used with 17 slides explaining the development of the program and outlining the advantages of connecting a database to a computer-assisted instruction system.

Balestri, Diane. "The Skeptics' Notebook: a Few Thoughts to Stimulate Conversation." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988.
Future/Effectiveness of Computer-assisted Instruction. The chapter presents the findings of a technology study group about the uses of academic computing in the classroom. The authors present examples of software serving the strategies they advocate: use of computers as tools and resources, as devices to help open instructional bottlenecks, and as catalyst for broad curricular change.

Balzano, Gerald. "Reconstructing for Design." Machine-Mediated Learning 2.1,2 (1987): 83-109.
Alternative Methods. The computer is not only a tool for making education more efficient, but a catalyst for reconstructing the curriculum across disciplines and across age levels, with a special emphasis upon the design-oriented learning specifically enabled by computers. Reconstructing the curriculum means both casting out obsolete pieces in light of new technology and introducing new pieces that combine previously separate disciplines. Design orientation entails both a renewed emphasis on synthesis as opposed to analysis and a greater focus on the value of perception in learning. In this paper, the author explores these ideas within and across the disciplines of mathematics and psychology and then presents a more detailed example of using computers for design-oriented learning in music. He shows that new kinds of computer-based learning environments for music "reconstruct the curriculum:" music explored in a design-oriented computer environment is seen as naturally including parts of mathematics and psychology. He also discusses the implications of this new orientation for the subject of programming and the structure of classrooms.

Beck, J. Robert, et al. "Computers and Medical Decision Making: a New Elective Course in Medical Information Sciences." RIME 85. 1985. 3-8.
Problem-solving-based Learning. The authors describe a fourth year elective course in microcomputing and medical decision-making which has been developed at Dartmouth Medical School. They have designed and pilot tested a syllabus, lecture notes, problem sets and computer programs.

Becker, Karl-Heinz, and Michael Dorfler. "Project Mens: Modeling and Experimenting with Nonlinear Dynamical Systems." Computer Assisted Learning. University of Surrey. Pergamon, 1989. 63-68.
Simulation vs. Authentic. This paper describes a project in Germany to develop and evaluate teacher training materials that will make the discoveries in the field of nonlinear dynamic systems, with a focus on cross-disciplinary aspects, accessible to students in secondary and higher education. Computer modeling of fractals will play a major role in the project.

Benedict, Susan, and Kenneth Coffield. "The Effect of Brain Hemisphere Dominance on Learning by Computer Assisted Instruction and the Traditional Lecture Method." Computers in Nursing 7.4 (1989): 152-156.
Kinds, Styles, Modes of Learning. This study explored the effect of brain hemisphere dominance on learning by computer assisted instruction and the traditional lecture method: previous research, reviewed here, has suggested that those in whom the right brain hemisphere is dominant will be primarily visual learners, those with left hemisphere dominant primarily auditory learners. After content related to the use of Roman numerals was presented using both computer-assisted instruction and the lecture method, analysis of variance demonstrated an interaction effect between brain hemisphere dominance and teaching method that supported the conclusions reviewed.

Bergeron, Bryan P., and Robert A. Greenes. "Clinical Skill-building Simulations in Cardiology HeartLab and EkgLab." Computer Methods and Programs in Biomedicine 30 (1989): 111-126.
Simulation vs. Authentic. The author describes HeartLab and EKGLab, two simulation-based programs for the Macintosh designed to teach medical students the essentials of auscultatory cardiac examination (with a stethoscope) and of electrocardiogram interpretation. He examines the issues considered throughout the development of these projects, including implementation language selection, program architecture, simulation design, patient models, and the approach to verification, pointing out that they are applicable to the design of any simulation-based system.

Berner, E. S. "Paradigms and Problem-solving: a Literature Review." Journal of Medical Education 59.8 (1984): 625-33.
Problem-solving-based Learning. Kuhn's conceptions of the influence of paradigms are used to explain the often conflicting research results in medical problem-solving. Underlying assumptions about problem-solving are explored in the light of data that demonstrate low correlations between different measures of problem-solving, inconsistent relationships between the amount of clinical experience and problem-solving ability, and the case specificity of performance. The author proposes a new paradigm emphasizing a multidimensional problem domain.

Berube, David M. "A Prospectus for the Future Development of a Speech Lab: Hypertext Applications." The 74th Annual Meeting of the Speech Communication Association, November 3-6, 1988. New Orleans, LA. 1988. 24 pp.
Hypertext/Hypermedia. This paper presents a plan for speech laboratories integrating modern communications technology. Following a look at the application of technologies

such as audio-video recording and playback, computer assisted instruction and testing programs, speech analysis and criticism programs, and advanced bibliographical systems, the author considers hypertext in some detail, focusing on its potential as a solution to the increasing demands of information management. Twenty-one references conclude the paper.

Bevilacqua, Ann F. "Hypertext: Behind the Hype." ERIC Digest August 1989: 3-4.
Hypertext / Hypermedia. **This digest defines the concept of hypertext, dividing it into static and dynamic categories. The author provides capsule descriptions of three prototype applications: (1) Intermedia, a large-scale multimedia system at Brown University; (2) the Perseus Project at Harvard University, which is developing interactive courseware on classical Greek civilization; and (3) Project Jefferson at the University of Southern California, which has developed several hypertext applications. Problems of hypertext systems, such as orientation to the database, cognitive overload, and compatibility are considered. A short glossary and a 6-item reference list are included.**

Bliss, Stephen D., M. Joy Gorence, and Donald Haight. "CD-ROM Applications in Education." Journal of Educational Technology Systems 18.1 (1989): 37-41.
Interactive multi-media. **The authors set up a CD ROM-based in-class resource center for research by secondary students and observed its use. Here they detail their findings. Half the 52 9th and 12th grade students to whom the computer was available used it for research: those who did responded favorably to the ease with which they located material. Among the authors' conclusions: CD ROM-based workstations can help students develop better research skills.**

Bloch, Ben, and Jonathan Bloch. "Ted Nelson at the BCS." New Media News Winter 1990: 6-9.
Hypertext / Hypermedia. **The authors summarize the criticism which Ted Nelson, one of the thinkers behind the concept of hypertext and the coiner of the term, has leveled at recent hypertext applications. Nelson views current applications as poor substitutes for the seamlessly integrated application of his visions and, further, as not even moving in the right direction: he is at work on an automatic, intelligent inking mechanism.**

Boeri, Bob. "Stalking the Hyperbook: Where to Find, and How to Recognize This Emerging Species." New Media News Winter 1990: 10ff.
Hypertext / Hypermedia. **This overview of "hyperbooks," or electronic documents with hypertext links, presents criteria for recognizing good hyperbooks (learning time, task efficiency, amount used, subjective satisfaction) and gives rules for the choice of appropriate material for hyperbooks (large body of information in related fragments, of which users need only a fraction at any one time). The author mentions delivery systems which meet these criteria as well as those which, in his view, do not.**

Booth, A. G., and E. J. Wood. "The Microcomputer in Biomedical Education." Progress in Medicinal Chemistry. Ed. G. P. Ellis and G. B. West. Elsevier Science Publisher, 1989. 26: 323-354.
Research and Evaluations. **In this extensive overview, the authors move from general information about microcomputers – what comprises them, how to choose one – to considerations of developing tutorials for students of medical biology, managing testing on the computer, using multimedia such as videodiscs, and integrating the computer with other pieces of laboratory equipment. They stress the importance of using the medium imaginatively, the potential of the computer in modeling systems, and the coming importance of communications for distance learning.**

Bork, Alfred. "The Potential for Interactive Technology." Byte February 1987: 201-206.

Future / Effectiveness of Computer-assisted Instruction. **The article outlines problems with education in the U.S. and proposes as remedy a radical revision of curricula, first as pilot project and then as sweeping nationwide program, to utilize interactive technology fully and thus permit individualized instruction even in times of teacher shortages.**

Briscoe, M. H., A. Byrne, B. Hicks , D. A. Care, P. A. Williams, and G. Jones. "Interactive Video Teaching Using a Home Microcomputer." Medical Education 21.1 (1987): 15-17.

Interactive multi-media. **This paper describes the use of a microcomputer to produce an interactive video system designed to introduce medical students to examination of the mentally ill. The author, who was involved in developing the program, sees the technique as ideally suited to demonstrate examination and treatment techniques in all medical specialties.**

Budin, Howard, Robert Taylor, and Diane Kendall. "Computers and Social Studies: Trends and Directions." The Social Studies. Jan/Feb 1987: 7-12.

Alternative Methods. The authors outline five areas in which new technology can have important positive impact in the teaching of social studies: software for working with computerized databases to provide a structure in which students learn how to make decisions by selecting, comparing, making inferences, and thinking critically about information; graphics as a means of presenting information; interactive software which allows students to enter data as well as answer questions; software which increases global understanding by giving students command of an expanded world of data, both textual and pictorial; and software which teaches aspects of social interaction and teamwork. They believe these directions are feasible because all reflect acknowledged social studies goals and because the technology to develop them is available now.

Burton, Vernon. "Teaching Historians with Databases." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988.

Large Databases and Lab Data. The author, a historian and longtime supporter of student research using original documents, describes various instructional projects using computers, focusing on those in which his students have analyzed manuscript US census records. He contends that these projects have not only been motivational but have also enabled students to get a feel for the complexities of work with data from the "real world." The supercomputer database project at Illinois will, according to Burton, allow more credible analysis among humanities researchers.

Burton, Vernon et al. "Historical Research Techniques: Teaching with Database Exercises on the Microcomputer." Social Science History 11.4 (1987): 433-448.

Large Databases and Lab Data. From their perspective that all contemporary humanistic scholars need to understand how computers produce their results in order to understand and evaluate the new social science research, the authors – an interdisciplinary team including a historian, a linguist and language scholar, and academic computing professionals – present a descriptive history of the prototype interactive history lessons they produced. The lessons, designed as a "tool that could...simulate the techniques and protocols used by quantitative historians to analyze and interpret source materials," utilized as a primary source manuscript census data and thus focused on the lives of common people rather than the "historical elite." The team plans further development work on database exercises, each to be progressively more flexible as a research tool.

Byers, T. J. "Built by Association." PC World.April 1987: 244-251.
Hypertext/Hypermedia. **The article considers issues of hypertext in conjunction with CD ROM technology. After supplying background and history on the concept of hypertext, the author describes hypertext applications for text data management and contrasts "static" hypertext like the Grolier Electronic Encyclopedia with "dynamic" hypertext systems (such as those possible with WORM drives) which enable users to add their own links; he sees the latter as ultimately more promising.**

Cafolla, Ralph. "Piagetian Formal Operations and Other Cognitive Correlates of Achievement in Computer Programming." Journal of Educational Technology Systems 16.1 (1987): 45-55.
Cognitive Styles and Personality Types. **The study demonstrates that the three factors tested – mathematics reasoning, verbal ability, and level of cognitive development – all predict success in computer programming ability. Implications for those who teach programming include the necessity of using concrete as well as abstract models for students who are having difficulty in learning programming.**

Calhoun, Margaret et al. "The Relationship of Age, Level of Formal Education, and Duration of Employment Toward Attitudes Concerning the Use of Computers in the Workplace." Journal of Medical Systems 13.1 (1989): 19.
Cognitive Styles and Personality Types. **The experiment detailed here showed, according to the authors, that those who are older, have less education, and have been employed for a longer period of time have a less positive attitude to the use of computers, and to change, in the workplace. To introduce computing into an environment successfully, they conclude, planners must also incorporate strategies to overcome anxiety and reluctance to change.**

Callison, Daniel. "Experience and Time Investment Factors in Public School Teacher Evaluation of Educational Microcomputer Software." Journal of Educational Technology Systems 16.2 (1987): 129-149.
Human Factors. **The article describes a two-year software evaluation project by teachers in various Indiana school districts. Conclusions indicate that various factors may influence the evaluator's final recommendation. One such factor is prior experience with the technological innovation in general and with similar programs in particular: inexperienced teachers gave appreciably lower ratings overall than did experienced teachers. Also, the project demonstrated that teacher evaluators tend to invest more time in the examination of software which supports what each currently does in his or her own classroom than in that which would represent a departure from present practice or structure. The author cites 31 references.**

Cantor, Jeffrey A. "A Systems Approach to the Design and Development of Interactive Videodisc Training." Journal of Educational Technology Systems 17.4 (1989): 255-271.
Interactive multi-media. **The article describes a U. S. Navy process for the systematic design and development of interactive videodisc courseware. Phases of the process include analysis and alternatives, system design, system development, and system test and evaluation. The article includes flowcharts.**

Carlson, David A., and Sudha Ram. "HyperIntelligence: The Next Frontier." Communications of the ACM 33.3 (1990): 311-321.
Hypertext/Hypermedia. **The authors discuss the ways in which mental models may be used to organize an individual's thoughts while forming a plan. They go on to describe a hypermedia system which they have developed for business managers which supports an explicit representation of a mental model as a network of associations among elements.**

Casteel, Clifton. "Effects of Chunked Reading Among Learning Disabled Students: An Experimental Comparison of Computer and Traditional Chunked Passages." Journal of Educational Technology Systems 17.2 (1988): 115-121.
Alternative Methods. The author-researchers, who note research indications that computer-assisted reading programs enhance achievement and that breaking sentences into groups of meaningfully related words ("chunking") enhances retention and comprehension, describe their investigation of the effects of two methods of presenting chunked reading. Of three groups of learning-disabled high school students, one received chunked passages via computer, a second was administered chunked passages in the traditional mode, and a third (control) group used computer-assisted instruction with non-chunked passages. In followup testing, the computer-assisted chunked group showed higher gains, but their mean score was not significantly better than that of the traditional chunked group. Conclusion: while separation of reading material into meaningfully related words significantly enhances reading comprehension, using computers as the method of presentation does not make a significant difference.

Cates, Jeanette S. "Delay of Feedback and Cognitive Task Level in Practice Exercises in Proceedings of Selected Research Papers." Annual Meeting of the Association for Educational Communications and Technology, January 14-19, 1988. New Orleans, LA. 1988. 20 pp.
Cognitive Styles and Personality Types. This study investigated relationships of the timing of feedback in programmed instruction in accounting and the cognitive levels of the tasks involved. While the author concludes that computer-assisted drills improve accounting learning at the introductory level, the results did not pinpoint any statistically significant correlation between the timing of feedback and cognitive task level. There is a list of 27 references.

Chin, Homer, and Gregory F. Cooper. "Case-based Tutoring from a Medical Knowledge Base." Computer Methods and Programs in Biomedicine 30 (1989): 185-198.
Alternative Methods. The past decade has seen the emergence of programs that make use of large knowledge bases to assist physicians in diagnosis within the general field of internal medicine. Such databases contain knowledge which covers a significant proportion of internal medicine. This paper describes the process of converting a subset of this knowledge base, in the area of cardiovascular diseases, into a format appropriate for use in teaching diagnostic techniques to medical students. The system generates simulated patient cases and uses these cases as a focal point from which to teach medical knowledge. The project demonstrates the feasibility of creating an intelligent, flexible instructional system for instructional purposes that uses a knowledge base constructed primarily for medical diagnosis.

Chu, Hsiang-Chi Julie. "Effects on Using On-Screen Learning Aids and Reading Performance." The Annual Convention of the Association for Educational Communications and Technology. Atlanta, GA. 1987. 18 pp.
Cognitive Styles and Personality Types. This study of enhancement of on-screen text as a learning aid to increase "mindful" processing of information did not reveal significant correlations between the underlining of on-screen text and learning. The author suggests areas for further research and appends tables of supporting data and a 33-item bibliography.

Clancey, William J. "Acquiring, Representing, and Evaluating a Competence Model of Diagnostic Strategy." The Nature of Expertise. Ed. R.

Glaser, M. Chi, and M. Farr. Hillsdale, NJ: Lawrence Erlbaum Assoc., 1988. Ch. 12: 343-418.

Problem-solving-based Learning. This extensive and detailed study concerns the development and workings of an expert system, the knowledge base of which is designed for use in tutoring medical students on meningitis diagnosis. In the course of explaining how the system was developed, the author addresses a number of questions which are of broad interest to developers of instructional software generally. These questions include considerations of the flow of information within a model, strategies for learning from models, and the relation between models or simulations and the real world. Numerous diagrams and a 58-item reference list accompany the study.

Clark, Kathleen M. "Recent Developments in Self-directed Learning." Journal of Continuing Education in Nursing 17.3 (1986): 76-80.

Problem-solving-based Learning. The author provides information about some current applications of self-directed learning in nursing education. She then briefly discusses trends in self-directed learning research and the implications for continuing nursing education.

Clark, Richard, James Kulik, Robert Tennyson, and William Winn. "Mere Vehicles." Symposium on the status of research in instructional technology sponsored by the Research and Theory Division of the Association for Educational Communications and Technology. Atlanta, GA. 1987. 1-42.

Research and Evaluations. The focus of this symposium is upon Richard Clark's controversial thesis that the method of instruction does not, in and of itself, have any bearing upon student achievement. Clark's paper reiterates this thesis, concluding with his argument that "media researchers need to orient themselves much more towards their 'parent' social sciences disciplines," such as cognitive psychology, and toward developments in instructional research. The Kuliks counter that computer-based instruction does in fact produce positive results but that certain effects noted in research on computer-based instruction do need further explication. Tennyson, who views media as only one component of the complex system that is instruction, recommends that educators trace media variables to specific learning processes to determine if they improve learning. Winn, agreeing with Clark that media do not account for the ways in which people learn, argues that educational technologists must "discover, promulgate, and understand" the higher-order methods which inform instructional design generally in computers and in other media.

Clark, Richard E. "Confounding in Educational Computing Research." Journal of Educational Computing Research 1.2 (1985): 137-148.

Research and Evaluations. The author argues that, despite considerable evidence in research that computer-based instruction enhances student learning, most of this research is confounded. Wherever computers are used to deliver instruction, any resulting change in student learning or performance may be attributed to the uncontrolled effects of different instructional methods, content and/or novelty. The evidence for this confounding places the independent variables in most of these studies in doubt and diminishes the role of educational computing research in the development of instructional theory – though not in instructional development or delivery. His conclusion: "researchers and educators should be reluctant to attribute learning gains either to the computer or to any unique quality of computers...., the most recent in a long cycle of media enthusiasms." They should instead see the computer "as a sophisticated and flexible delivery vehicle for instruction and testing."

Clark, Richard E. "The Future of Technology in Educational Psychology." The Future of Educational Psychology. Ed. M. C. Wittrock and F. Farley. Hillsdale, NJ: Lawrence Erlbaum Assoc., 1989. Ch. 6.

Research and Evaluations. The author here looks at the barriers and benefits which educators have encountered in making technology a vehicle for putting the discoveries of educational psychologists to work in the classroom. He argues that technology has a key role in the recent shift from behavioral to cognitive learning theories and that historically, technology has replaced craft orientations in medicine and engineering and is therefore likely to become a principal focus for education. Barriers to technology, the author believes, have included our own understanding of prescriptive research and, perhaps, resistances to research-based technologies. He presents examples of instructional technologies that in his view tap the potential of psychologists' findings.

Clark, Richard E., and Gavriel Salomon. "Media in Teaching." Handbook of Research on Teaching. Ed. M. C. Wittrock. NY: MacMillan, 1985. 3: Ch. 16, 464-478.
Research and Evaluations. This chapter, in the context of a review of research on media in teaching, presents information about various media comparison studies and the shift of focus to cognitive aspects of media attributes. The authors conclude with a paradigm for future developments in research, which they believe should be conducted in the context of and with reference to similar questions in the general cognitive sciences. There is a 128-item reference list.

Clark, Richard E. "Reconsidering Research on Learning from Media." Review of Educational Research 53.4 (1983): 445-459.
Research and Evaluations. Reviewing recent studies of media's influence on learning, the author attests that no learning benefits are gained from employing any specific medium to deliver instruction. He argues that research which purports to show performance or time-saving gains from one or another medium is vulnerable to compelling rival hypotheses concerning the uncontrolled effects of instructional method and novelty. He describes problems with current media attribute and symbol system theories. More promising research, he suggests, would investigate those particular qualities of various instructional methods that contribute to increases in achievement. He cites 39 references.

Clark, Richard E. "Research on Student Thought Processes during Computer-based Instruction." Journal of Instructional Development 7.3 (1984): 2-5.
Research and Evaluations. To illustrate the perspective underlying research on thought processes during instruction, the author presents summaries of cognitive research in motivation, computer effects, learner control, instructional methods, left-right brain effects, and anxiety as these areas relate to instructional design. He encourages design professionals to take advantage of developments in cognitive studies such as those he outlines: for example, the need to distinguish among tasks well suited to cognitively-based design and those better suited to behaviorally-based design.

Clark, Richard E., and Alexander Voogel. "Transfer of Training Principles for Instructional Design." ECTJ 33.2 (1985): 113-123.
Research and Evaluations. The authors endeavor to establish that instructional technology applications often result in failures by students to transfer their training to different problems in different settings, failures which they attribute to the inappropriate mixing of behavioral and cognitive instructional design models. Having described the principles that underlie transfer, the authors suggest that, in order to achieve transfer, those selecting instructional methods must carefully match levels of transfer, types of learning objectives, and student aptitude levels. They make specific suggestions of instructional design prescriptions that support different levels of transfer for different types of learning objectives and learners and conclude with suggestions for needed research.

Cohen, V. B. "Reexamination of Feedback in Computer-based Instruction: Implications for Instructional Design." Educational Technology January 1985: 33-37.
Cognitive Styles and Personality Types. The author, a designer of computer-based instructional materials, demonstrates through a brief review of the literature that positive feedback is at best neutral and sometimes negative in improving learning among users of instructional software and that feedback on wrong answers which guides the student toward understanding and correcting errors is preferable. She also suggests that immediate feedback is important for beginners, while end-of-session feedback is more helpful for students who have already attained some mastery.

Coll, Richard, and Joan H. Coll. "Cognitive Match Interface Design, A Base Concept for Guiding the Development of User Friendly Computer Application Packages." Journal of Medical Systems 13.4 (1989): 227-235.
Human Factors. The authors present a concept which unites various prescriptions for creating and implementing an effective user interface. They see as the key issue making the system interact with the user's own thought processes. As example, they describe a system they developed to create and store patient records for the health care industry.

Collis, Betty, Antoinette Oberg, and Wes Shera. "An Evaluation of Computer-based Instruction in Statistical Techniques for Education and Social Work Students." Journal of Educational Technology Systems 17.1 (1988): 59-71.
Research and Evaluations. Noting that students in education and social work traditionally regard statistics with negative attitudes which impede their understanding and use of research methodology, the three instructor-authors evaluate the use of computerized tutorial support for elementary statistics instruction by their students in five different graduate and undergraduate education and social work courses. The instructors incorporated the computerized support materials in various ways, yet the use of the tutorials was associated in all the classes with positive outcomes for the students, both in terms of statistical concepts and of attitudes toward statistics. The authors found the computerized mode of instruction effective despite many students' lack of previous experience with computers: the mode was also compatible with the students' self-expressed preferences for learning environments.

Computer Science Technology Board, "Scaling Up: A Research Agenda for Software Engineering." Communications of the ACM 33.3 (1990): 281-293.
Research and Evaluations. This summary of a report, itself a distillation of the deliberations of a group of software engineers in a workshop on setting research priorities, begins by setting forth in some detail the complex and severe problems posed by large-scale software development and goes on to propose specific short-term and long-term actions to counter these problems in the areas of agenda research, the establishment of perspective, engineering practice, and research modes. Among the engineers' conclusions: a necessary first step in solving this problem is to adopt a more realistic vision of the complex software system development process, and following this the direction and conduct of software engineering research should be both broadened (for instance, by fostering interactions with practitioners) and made more systematic (through codification as well as through infusion of more mathematics, science, and engineering).

Covey, Preston K. "New Media & Values Education." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988. 15 pp.

Interactive multi-media. **The paper presents a rationale for the application of multimedia technology to ethics and values education, arguing that educational researchers who evaluate such technology often ignore the importance of a visual and learner-centered approach. The author discusses several such applications which he has developed, including an interactive program which presents students with video of actual ethics cases, such as a burn victim fighting for his own right to die and asks them to weigh choices.**

Cropp, David. "Are Media Needs Being Met for the Beginning Teacher?" Journal of Educational Technology Systems 18.3 (1990): 215-234.
Interactive multi-media. **The article describes surveys conducted in Kansas to answer the title question. Results suggest that the use of videotape and computers in the elementary school classroom is rapidly increasing and that their use is being restrained only by the volume of equipment available to the teacher.**

Cumming, Alister. "Change, Organization, and Achievement: Teachers' Concerns in Implementing a Computer Learning Environment." Journal of Educational Technology Systems 17.2 (1988): 141-163.
Human Factors. **This study is an analysis of interviews over a one-year period with two experienced teachers implementing a new computer program in their elementary school classes. The teachers were fundamentally concerned with learning to accommodate changes required by the innovation, organizing new classroom routines around the computers, and seeking indications of students' achievements through their uses of the computers. These considerations appeared integral to the teachers' senses that they were making effective use of the computer learning environment.**

Cunningham, Donald J. "Good Guys and Bad Guys." ECTJ 34.1 (1986): 3-7.
Research and Evaluations. **The author takes issue with Richard Clark's argument that the superiority of computer-based instruction is unproven and that continuing research on computer-based versus traditional instruction should be better controlled, with more precisely defined variables and more attention to the placement of such research within the context of social science research generally. In this article, Cunningham thus articulates his philosophical objections to Clark's conclusions, which he views as infected with logical positivism: "we will never be able to say that computer-based instruction is better or worse than traditional instruction without embedding that statement within particular interpretive contexts (social, historical, or cultural)." He argues that researchers' energies would be better invested in exploring the potential utility of numerous instructional techniques rather than in pitting them against each other.**

Dahlgran, Roger. "An Economic Perspective on Teaching-Innovation." Journal of Educational Technology Systems 18.3 (1990): 191-206.
Human Factors. **An agricultural economist applies an economic model to learning and then adds teaching innovations, especially those relying on computing, to the model. His conclusion is that the evaluation of instructional innovation through the comparison of test scores may ignore the impact of labor-saving innovations, and thus may not measure accurately the learning of more advanced reasoning and decision-making skills. There is a 12-item reference list.**

Dalton, V. W. and M. J. Hannafin. "The Role of Computer Assisted Instruction in Affecting Learner Self-esteem: a Case Study." Educational Technology December 1984: 42-44.
Kinds, Styles, Modes of Learning. **From a study of eighth grade mathematics students, the authors hoped to learn whether the use of computer assisted instruction carefully designed to be non-judgmental could foster self-esteem. While results on this question were not statistically significant, they believe that further research is warranted.**

Darabi, G. Abbas, and John V. Dempsey. "A Quality Control System for Curriculum-based CBI Projects." Journal of Educational Technology Systems 18.1 (1989-90): 15-31.

Control Issues. Written by two Florida State University computing professionals who have been involved in developing more than 300 instructional modules for the U. S. Army's Job Skills Education Program, the article discusses the significance of quality control for a curriculum-based computer-based instructional program and describes one way to establish a quality control system. The system breaks up the quality control activities into three major areas, pre-programming, on-line review, and final review, with each area incorporating multiple review and revision stages that correspond with the production stages of a particular project. The authors, who also include lists of specific techniques for protecting a quality control system, suggest that their system is generic enough to be used, with modifications, on other large-scale computer-based instruction projects.

Das, Ishwar, Namita Agrawal, and Anal Pushkarna. "Educational Technology and Alternatives to Traditional Lecturing." Journal of Educational Technology Systems 16.4 (1988): 337-342.

Alternative Methods. The authors surveyed students who viewed videotaped demonstrations of laboratory experiments prior to performing the experiments themselves in large laboratory-based courses at McGill University. After a very brief review of the results, they present extensive lists of the benefits students gain from the use of such pre-lab presentations and extrapolate their findings to the use of videodiscs in similar settings. They conclude by emphasizing the importance of developing well-planned educational software.

Davis, George E., and Stephen R. Schach. "Mentor/MacVideo: A Videodisc Authoring System for Educators Who Are Not Computer Specialists." Journal of Educational Technology Systems 16.2 (1987): 171-194.

Interactive multi-media. The article describes a videodisc authoring system designed to enable educators to construct video-based course materials and edit videodiscs without specialized knowledge. The authors include descriptions from the point of view of the student user of materials created as well as that of the instructor/author. Using as evidence the several demonstrably usable products integrating a wide variety of software and hardware for a broad range of purposes which instructors at various universities have constructed,they conclude that the objectives they had in developing the system have been met.

Davis, Wesley D. "An Empirical Assessment of Selected Software Purported to Raise SAT Scores Significantly When Utilized With Short-Term CAI on the Microcomputer." 1985. 102 pp.

Cognitive Styles and Personality Types. This extensive study evaluated Krell's 1981-82 Scholastic Aptitude Test (SAT) preparatory series software, purported to raise students' scores substantially after only a short term of computer-assisted instruction (CAI). Results showed that, although individual student score gains under these conditions may be high, Krell SAT software utilized under controlled CAI conditions produces only modest group score gains.

Davison, Betsy. "SCAN: Setting up a National Database in Global/International Education." The Social Studies Jan/Feb 1987:

Alternative Methods. The article describes a national electronic database System for Communication and Networking, or SCAN, developed by Global Perspectives in Education, Inc., to assist educators in locating current materials in international education. Currently a pilot project funded by the Exxon Education Fund and the NEA, among other agencies, SCAN has as its long-term goal the opening of a comprehensive

database for online searches. The total number of bibliographies and publications included in SCAN at the time of the article's publication was roughly a thousand, with a major expansion being planned.

Diserens, D., M. W. Schwartz, M. Guenin, and L. A. Taylor. "Measuring the Problem-solving Ability of Students and Residents." Journal of Medical Education 61.June (1986): 461-466.
Problem-solving-based Learning. **The authors investigated the validity and reliability of the computer program developed at the University of Pennsylvania School of Medicine and the Children's Hospital of Philadelphia which presents simulated patient cases and then scores participants' clinical problem-solving by comparison with that of five faculty members. Total scores differed significantly only on the most difficult of the cases. Implications of selecting a battery of cases for the system are discussed.**

Dologite, D. G. "Measuring Microcomputer Literacy." Journal of Educational Technology Systems 16.1 (1987): 29-43.
Kinds, Styles, Modes of Learning. **This article discusses the results of an ongoing research study to measure microcomputer literacy in which the author surveyed college students about to begin a microcomputer course on their previously acquired microcomputer literacy. In connection with this survey, he discusses the development of a microcomputer literacy index for measuring student aptitude, which, he argues, institutions critically need.**

Drake, Miriam A. "Library 2000-Georgia Tech: A Glimpse of Information Delivery Now and In the Year 2000." ONLINE November 1987: 45-48.
Hypertext/Hypermedia. **Georgia Institute of Technology's Director of Libraries describes electronic access to the catalog and to four extensive periodical databases recently implemented at the institution: she sees the resultant environment as one in which students actively initiate learning.**

Duchastel, P., R. Brien, and J. Imbeau. "Models of Learning in ICAI." Journal of Educational Technology Systems 17.2 (1988): 165-172.
Kinds, Styles, Modes of Learning. **The title acronym stands for "intelligent computer-assisted instruction." The authors claim that it differs from traditional computer-assisted instruction in the flexibility of interaction it makes possible between the student and the program. In their view, this flexibility encourages an active and exploratory approach to learning rather than a receptive, objective-oriented one. They set forth forms of learning which have been proposed in the psychological and educational literature and review various intelligent computer-assisted instruction systems in terms of the kinds of learning supported, concluding that the potential power of such systems to foster learning is still greater than our ability to specify formally the rules which regulate learning in complex situations such as those involved in tutorial dialogues.**

Eisele, J.E. "Computers and Learning: Some Needed Research." Educational Technology 14.4 (1984): 34-35.
Research and Evaluations. **Writing in the journal's "Instructional Computing" column, the author poses eight questions which should, in his view, be answered before institutions invest heavily in hardware for instructional use. The questions he poses for research are quite broad: they include, for instance, "Can students learn from computers well enough to demonstrate mastery of what teachers want them to learn?" and "What subjects might most beneficially be taught by computer?"**

Emerson, Lawrence. "Can Artificial Intelligence Put 'the Master Teacher in a Computer'?" Instruction Delivery Systems Sept/Oct 1987: 8-11.
Human Factors. **The article outlines the problems which face the developers of instructional software looking to implement truly effective interactive capacity in their**

programs. These include limitations of microcomputers and of understanding of the tutorial process. The author briefly describes some pilot projects in the area of artificial-intelligence-based tutorial software and ends by summarizing some characteristics of the well-developed intelligent instructional system. A sidebar presents a glossary of artificial intelligence terms.

Fann, Gail L., David H. Lynch, and Patricia Murranka. "Integrating Technology: Attitudes as a Determinant of the Use of Microcomputers." Journal of Educational Technology Systems 17.4 (1989): 307-317.
Kinds, Styles, Modes of Learning. **A survey of undergraduates before and after they completed required assignments in business communication classes on the microcomputer constituted this study, designed to investigate how attitudes affect students' use of computers. Conclusions: students with more computer experience are more likely to have positive attitudes toward computers than those with less experience, and students with a more positive attitude are more likely to complete assignments on computers and will more likely use computers in the future more than those with less experience.**

Flynn, Marilyn L. "The Potential of Older Adults to Respond to Computer-Assisted Instruction." 17.3 (1989): 231-241.
Cognitive Styles and Personality Types. **This study examines patterns of computer use and response to computer-assisted instruction among older adults (45-70). Findings support the expectation that older people can be enthusiastic computer users irrespective of education or other socioeconomic variables. The results raise interesting questions about the negative bias which may be introduced by classroom instructors as mediators of instructional technology. The bibliography contains 23 items.**

Frederiksen, Norman. "Implications of Cognitive Theory for Instruction in Problem Solving." Review of Educational Research 54.3 (1984): 363-407.
Problem-solving-based Learning. **The author describes how high levels of proficiency in problem solving are acquired and suggests how these skills might best be taught, keeping in mind the distinction between well- and ill-structured problems. Various unresolved issues concerning instructional methods are considered.**

Friedlander, Larry. "The Shakespeare Project." Invitational conference on Multimedia in Education. Cupertino, CA. June 19-20, 1986. 30 pp.
Interactive multi-media. **The paper describes the Shakespeare Project at Stanford, an interactive videodisk computer program to permit students to study and design theater. The author, who has shaped the academic aspects of the project, describes its features and testing of the prototype with students of various ages, concluding that the program provides a model for conveying rich, complex, and multiple views of material in arts instruction in general.**

Friedman, Bruce A. "Informating, Not Automating, the Medical Record." Journal of Medical Systems 13.4 (1989): 221-225.
Large Databases and Lab Data. **The article advocates using the staff time freed by the increasingly automated nature of medical records for analysis of the databases that are being created and expanded by computerization. Such analysis can enhance quality and efficiency in hospital work, the author believes. He explains the utility of laboratory information systems for database management and for the generation of reports.**

Frischer, Bernard. "Cicero: A Framework for Multimedia Projects for Classics." Learning Tomorrow: an Invitational Conference on Multimedia in Education. Cupertino, CA. June 19-20, 1986.

Interactive multi-media. This paper focuses on plans for a computerized multimedia expert system in classics. Its author, one of the system's developers, describes the framework of "Cicero:" a core of multimedia databases, scholarly utilities for using and modifying them, and teaching applications which use the utilities and databases. He then illustrates student use of the system for a lesson on the city of Rome.

Garrett, T. J., David G. Savage, and Gerry Hendrickson. "The Hopes and Challenges of Generic Videodiscs for Medical Education." Instruction Delivery Systems January/February 1989: 23-24.
Interactive multi-media. Noting the cost benefits of using a generic videodisc of images with a commercially available authoring system, the authors describe a project in which they developed a videodisc program for providing instruction on the use of the peripheral blood smear in the evaluation of patients with anemia. They include a list of the criteria they used in selecting an authoring system, as well as a summary of the initial version of the program to be tested by medical students and residents.

Gibbons, Andrew S. "Instructional Technologists Must Play a Stronger Role in AI Development." Instruction Delivery Systems Sept/Oct 1987: 12-16.
Human Factors. After making the point which the title states, the author describes a rule-based plan for handling the strategic components of an expert instructional system which he believes will accommodate virtually any school of thought on instructional strategy. The plan involves breaking down each segment of the instruction into the smallest units possible, each to be addressed separately by the software.

Gist, Thomas, et al. "The Air Force Academy Instructor Workstation (IWS): II. Effectiveness." Journal of Educational Technology Systems 17.4 (1989): 285-295.
Research and Evaluations. This article discusses the results of measuring the in-class effectiveness of a computer controlled instructor workstation at the U.S. Air Force Academy. The workstation was used in an introductory calculus-based physics course. It provided computer control of the presentation of videodisc scenes in support of the lecture. The authors found no significant difference in the performance of the students, but did see a significant improvement in their attitude. Instructor reaction was generally favorable. The authors also discuss the pedagogy used in developing the lessons and the design of the evaluation.

Glenn, Allen D., Nancy A. Kozen, and Richard A. Pollack. "Teaching Economics: Research Findings from a Microcomputer/Videodisc Project." Educational Technology March 1984: 30-32.
Alternative Methods. The authors describe their pilot study of computer-controlled individual instructional units in various Minnesota high schools. The nine-week introductory course, which utilized videodisc players and Apple II computers, improved student understanding of the concepts of traditional economics. Conclusion: there is potential for use of microcomputer and videodisc technology in teaching specialized or advanced subjects sometimes dropped from high school curricula for lack of sufficient student enrollment.

Goetzfried, Leslie, and Michael Hannafin. "The Effect of the Locus of CAI Control Strategies on the Learning of Mathematics Rules." American Educational Research Journal 22.2 (1985): 273-278.
Control Issues. This study examined the effects of the locus of three computer-assisted instruction strategies on the accuracy and efficiency of mathematics rule and application learning of low achieving seventh grade students: an externally controlled adaptive strategy, an individually based learner control with advisement strategy, and a linear control design strategy. The researcher-authors found significant differences

among the strategies, with the linear strategy proving more effective for the youngest and least able students, perhaps because these students do not have the background knowledge to make judgments about their own progress and need for additional instruction. The implication is that greater degrees of learner control are more appropriate for more experienced learners.

Grams, Ralph R., and Z. Ming Jin. "The Natural Language Processing of Medical Databases." Journal of Medical Systems 13.2 (1989): 79-81.
Large Databases and Lab Data. The authors, who present a series of design specifications that would facilitate the processing of medical databases which will, in their view, begin to replace print media within the next decade. Tables and charts illustrate their points.

Grant, J., and P. Marsiden. "The Structure of Memorized Knowledge in Students and Clinicians: an Explanation for Diagnostic Expertise." Medical Education 21 (1987): 92-98.
Problem-solving-based Learning. The authors provide evidence of a consistent difference in the memory structures of novice and expert clinicians. The numbers of interpretations made and the numbers of forceful features identified did not differ significantly between groups. However, the actual interpretations made and the forceful features identified did differ significantly between groups, thus demonstrating the marked differences in the precise content and structure of thought, according to degree of diagnostic expertise.

Groen, Guy J., and Vimla L. Patel. "Medical Problem-solving: Some Questionable Assumptions." Medical Education 19. March (1985): 95-100.
Problem-solving-based Learning. The authors argue that the use of the hypothetico-deductive method is characteristic of novices rather than experts. They claim that experts use 'strong methods', dependent upon a highly elaborated and structured knowledge base, not the hypothetico-deductive method. More research is needed before confident claims can be made about the method used in clinical reasoning by real experts.

Groen, Guy J., and Vimla L. Patel. "The Relationship Between Comprehension and Reasoning in Medical Expertise." The Nature of Expertise. Ed. M. Chi, R. Glaser and M. Farr. Hillsdale, NJ: Lawrence Erlbaum Assoc., 1988. Chapter 10.
Problem-solving-based Learning. In this chapter, the authors explore the possibility that what is needed is a theory of comprehension together with a more precise method of empirically determining the verbal analogue to the perceptual notion of a pattern. Among their conclusions is the claim that medical specialists do in fact exhibit the same kind of forward reasoning that one would expect from other domains.

Hartley, J.R. "Some Psychological Aspects of Computer-assisted Learning and Teaching." Programmed Learning and Educational Technology 22.2 (1985): 140-149.
Cognitive Styles and Personality Types. The author traces the expansion of computer-aided learning developments from task-based systems to systems in which learners develop and organize their own knowledge structures. Relating these systems to the techniques of knowledge representation arising from artificial intelligence, techniques he views as of value for student modeling and for designing more intelligent computer-assisted learning, the author recommends a greater involvement of psychologists. The article includes a literature review and a 52-item reference list.

Hasselbring, Ted, et al. "An Evaluation of a Level-One Instructional Videodisc Program." Journal of Educational Technology Systems 16.2 (1987): 151-169.

Interactive multi-media. **The authors used a controlled study to evaluate a videodisc program designed to teach fractions to elementary students. Their findings support the conclusions that the use of the "Mastering Fractions" program resulted in significant gains in fraction skills and computations and, further, that the gains in achievement resulted from instructional content of the program, not the novelty of the medium.**

Hazen, Margaret. "Instructional Software Design Principles." Educational Technology November 1985: 18-23.

Control Issues. **A courseware development director at UNC Chapel Hill discusses four principles for instructional software design: learner/computer interaction, learner control, sequencing of instructional events, and graphics screen design. The article, which includes 29 references, sets forth numerous guidelines relating to each principle considered and concludes with a summary of these guidelines.**

Head, Thomas, and David Moore. "The Effect of Graphic Format on the Interpretation of Quantitative Data." Journal of Educational Technology Systems 17.4 (1989): 337-343.

Cognitive Styles and Personality Types. **Results of the study to determine how and what student are learning from graphics, although inconclusive, hint that learners recall information presented in tabular format more easily than they do that presented in graphical format. This indication may be of interest to instructional software designers.**

Henry, John B. "Technology in Education - Exploration into Better Teaching/learning." Computers in Medical Education: A symposium presented by the University of Pennsylvania School of Medicine in association with Apple Computer, Inc., and the Health Science Libraries Consortium. Philadelphia, PA. 1990.

Future / Effectiveness of Computer-assisted Instruction. **The president of SUNY's Health Science Center presents a rationale for the use of personal computers in medical education and by professionals in the health field, arguing that the knowledge explosion necessitates reliance on computer information access.**

Hines, Stephen J., and Steven A. Seidman. "The Effects of Selected CAI Design Strategies on Achievement, and an Exploration of Other Related Factors." Annual Meeting of the Association for Educational Communications and Technology. New Orleans, LA. 1988.

Cognitive Styles and Personality Types. **This study examined the effects on computer-assisted instruction of feedback and of the amount of control the learner has over the instruction. It also considered the influence on achievement of such factors as computer anxiety, self-concept, learning style, and gender. While the data showed no significant difference in achievement for either the control or feedback variables, it did suggest that female students were more computer-phobic than males and less likely to have taken a computer course. Neither difference correlated with achievement scores; in fact, the female students achieved significantly higher scores. It was also determined that students who had taken a computer course had more positive self-concepts than students who had not. The text is supplemented by 3 tables and 45 references.**

Hmelo, Cindy. "Computer-assisted Instruction in Health Professions Education: a Review of the Published Literature." Journal of Educational Technology Systems 18.2 (1989): 83-101.

Research and Evaluations. **The author analyzes a selection of articles regarding the use of computer-assisted instruction in the education of health professionals over the past 20 years, paying particular attention to applications developed for the microcomputer in the areas of tutorial courseware, simulation courseware, and interactive multimedia. Her conclusion: despite the numerous reports of computer-assisted instruction use, there has not been sufficient research on its effectiveness in medical, nursing, and allied health education, nor has there been much work on those features of such instruction that lead to improved learning. She urges the importance of increased research: considerations of successful and less successful software programs in relation to learner characteristics, for instance.**

Hodges, Daniel L. "How the Use of Cognitive Psychology Findings Can Raise the Productivity of Computer-Assisted Instruction." National Conference of the League for Innovation in the Community College. Miami, FL. 1986.

Cognitive Styles and Personality Types. **The author provides an overview of the principles of cognitive psychology that can be used to enhance the effectiveness of computer-assisted instruction and presents a list of 17 specific research-based guidelines for the development of instructional software.**

Hoekema, Jim. "Designing for CD-I: Videodisc Experience Helps, But It's a New Medium." Instruction Delivery Systems May/June 1988: 22-25.

Interactive multi-media. **Designing for interactive CD ROMs involves predicting the technical and psychological results of using new capabilities in certain ways, the author notes. He goes on to point out that, as CD ROMs are increasingly found outside the "dedicated" environments in which interactive videodisks were utilized, ease of use becomes an ever more important goal in CD ROM design: the other essential ingredient of any good interactive program, in his view, is a pattern of frequent, meaningful interactions.**

Hoffman, Ruth I. "Educational Technology for Elementary and Middle Schools." Journal of Educational Technology Systems 16.4 (1988): 299-314.

Alternative Methods. **Mathematics programs in elementary and middle schools, the author avers, have remained essentially unchanged for 50 years. This article summarizes the work done at the University of Denver Mathematics/Computer Laboratory in two projects funded by the National Science Foundation to remedy this situation. The first revised the K-6 mathematics curriculum and the computer literacy program. The second, an institute for 40 middle school teachers, showed them how to incorporate computers, calculators, and models into their classroom teaching. The 60-hour institute was videotaped, and every attendee was given an edited two-hour version to use when they themselves conduct inservice programs in their turn.**

Itoga, Stephen, Kent Bridges, Lawrence Frederick, and Richard I. Uyeda. "The AI Microscope Learning Environment." Journal of Educational Technology Systems 18.1 (1989): 3-14.

Alternative Methods. **In the study described here, researchers at the University of Hawaii at Manoa developed introductory tutoring modules in biology on scientific workstations. The focus in this article is on their experience while creating a laboratory exercise on leaf anatomy on a windowed workstation. Their discussion emphasizes the programming issues of the project but also notes as a fundamental design issue their commitment to put users in charge of all aspects of sessions, so that the users view such systems as support tools rather than as "spying mechanisms" for evaluation.**

Ives, William. "Computerizing the Development of Interpersonal Skills." Instruction Delivery Systems March/April 1990: 12-15.

Interactive multi-media. To demonstrate that the current computer technology most likely to promote interpersonal skills training is interactive video instruction, the author sets forth an instructional model offering five levels of learning, three of which are made possible by automated feedback. The author views CD ROM technology as offering an appropriate delivery system for such automated feedback. The article includes a diagram of the process it describes.

Jackson, Gregory A. "Settling Down With Athena: Further Notes on Computing in MIT Living Groups." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988.

Alternative Methods. This paper presents a detailed analysis of the uses to which Project Athena was put in the initial years of its implementation among living groups and its effect upon those living groups. Athena is a project formulated by Massachusetts Institute of Technology faculty with support from IBM and from the Digital Equipment Corporation to make powerful workstation-level computing routinely available to undergraduates and to foster the development of curricular materials exploiting this environment. Effects reported in the two years of study here reported included the transformation of the residence into an academic environment, promotion of social integration within the living groups, recognition of financial concerns that might arise between living groups and the institution about the provision of computing resources, benefits to some individuals rather than to the group, and the importance of key individuals within groups as trainers and troubleshooters.

Jacobson, Michael, and Martha Weller. "A Profile of Computer Use among the University of Illinois Humanities Faculty." Journal of Educational Technology Systems 16.2 (1987): 83-98.

Alternative Methods. The authors surveyed faculty of the School of Humanities of the University of Illinois at Urbana-Champaign regarding their frequency of computer use, level of general computing skills, computers interest, and anxiety regarding computers according to respondent rank, sex, and age. The respondents were generally self-trained in computer use, indicated positive attitudes to computers, and made frequent use of them. Faculty perceptions of obstacles to computer use in the humanities indicate a need to address issues of funding for hardware, quality of software, training, and technical support. The main faculty interests in applications software include word processing (93% using or interested in using), desktop publishing (43%), graphics (40%), database management (38%), communications (33%), and computer-assisted instruction (26%). While the authors believe that humanities faculty do not have the same level of involvement in computing as faculty in more "technical" disciplines, they found the humanists studied, as a group, clearly not intimidated by the technology.

Jason, Hilliard, MD. "Will Computers Dehumanize Medical Care and Education?" Journal of Family Practice 18.4 (1984): 525-527.

Human Factors. Acknowledging that computers may relieve much medical drudgery, the author quotes a friend's warning that "the measurable tends to drive out the important" and cautions that physicians use time freed by the computer to give the personalized kind of care each individual deserves, and, in general, use the technology to make the profession more humane.

Jay, T.B. "Computerphobia: What to Do about It." Educational Technology January 1981: 47-48.

Cognitive Styles and Personality Types. After a description of "computerphobia" and its causes, the author suggests steps that individuals and institutions can take toward remedy. A sidebar gives guidelines for a two- to three-day introductory computer seminar.

Jelden, D.L. "CMI Unit Test Item Presentation/Feedback and Its Effect on Final Examination Performance: Staff Study." Journal of Educational Technology Systems 16.2 (1987): 99-109.

Tests and Evaluation Methodology. The study in which the author was involved at the University of Northern Colorado addressed the instructional characteristics of computer-delivered unit tests on oceanography administered with several types of item feedback in different modes of presentation to students using computer-assisted interactive tutorials. The PHOENIX CBT system was used to compare the levels of achievement on final exam scores to the modes of test presentation and the degree and types of feedback provided during the unit tests. The study's conclusions, relevant to computer managed authoring systems developers and testing personnel, include these: corrective feedback improves achievement scores; immediate feedback on specific items is more beneficial than delayed feedback; low-ability students benefit more from corrective test feedback than high-ability students.

Johnston, Jerome, and Susan Gardner. The Electronic Classroom in Higher Education: A Case for Change. National Center for Research to Improve Postsecondary Teaching and Learning, 1989.

Future / Effectiveness of Computer-assisted Instruction. This report supports an NCRIPTAL videotape which uses examples from five institutions to show examples of faculty in every discipline using computers to enhance some aspect of student learning. This report provides a transcript of the videotape and a description of the case study methodology.

Johnston, Jerome. "Electronic Information: Literacy Skills for a Computer Age." Technical Report No. 86-F-001.1. University of Michigan. 1986.

Large Databases and Lab Data. The author distinguishes the skills needed for dealing with electronic text from those appropriate to printed text and offers some consideration of how, when, and where these skills should be taught. He emphasizes the potential of electronic technology for transforming information and outlines an agenda of issues for college administrators and faculty, including the norms and ethics of the new universe of discourse and the appropriate distribution of the associated costs.

Jonassen, David H. "Learning Strategies: A New Educational Technology." PLET 22.1: 27-34.

Cognitive Styles and Personality Types. The author reviews developments in educational psychology throughout this century with a view to the integration of learning strategies into instructional materials. He recommends that any instructional material designed to improve "learning to-learn" should "talk about itself" and suggests the desirability of research into the relative effectiveness of evident versus embedded learning strategy, both concepts which bear upon software design.

Jones, Tom. "C.A.S.T. - a Level IV Sonar Trainer." Journal of Educational Technology Systems 16.1 (1987): 65-73.

Interactive multi-media. The article describes the development of a trainer-simulator on the classification of sonar echoes for use in a course given by the Canadian military. The rationale for the project was to test the feasibility of innovative training technologies and to evaluate the applicability and potential of such technologies for future initiatives. On the basis of the very considerable reductions in the time students required to master the material, the author concludes that such trainer-simulators are effective systems of instructional delivery for military applications.

Joseph, Guy-Marie, and Vimla L. Patel. "Domain Knowledge and Hypothesis Generation in Diagnostic Reasoning." Medical Decision Making 10.1 (1990): 31-46.

Problem-solving-based Learning. **The authors analyze the problem solving process of two groups of subjects, one high-domain-knowledge endocrinologists, and the other low-domain-knowledge cardiologists. The differences between the performance of the two groups lead to the conclusion that there is a two stage problem solving process, with domain specific knowledge more important in evaluating hypotheses than in generating them.**

Jungck, John R, and Susan C. Jungck. "Ideological Components in the Construction of Computer Curricula." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988. 6 pp.
Research and Evaluations. **From the perspective of a liberal arts professor in a small college (Beloit), the author argues that computers in education "ought to be means serving the ends of liberation." He sets forth what he considers to be important subjects for debate, such as equity of access and the challenge posed by simulations to traditional teaching methodology.**

Jungck, John R. "A Problem Posing Approach to Biology Education." American Biology Teacher 47.5 (1985): 264-266.
Alternative Methods. **Within the context of his proposal that biologists adopt an interactional teaching style which poses questions on students' conceptual foundations of a subject, the author notes as one of several ways to compensate for the narrow and didactic focus of textbooks the importance of developing "computer software that builds experimental universes which provide students with professional tools to develop long-term research-like strategies for scientific problem solving in a very short time."**

Jungck, John R., and John N. Calley. "Strategic Simulations and Post-Socratic Pedagogy: Constructing Computer Software to Develop Long-term Inference through Experimental Inquiry." American Biology Teacher 47.1 (1985): 11-15.
Simulation vs. Authentic. **The authors, who argue that "computer software can be written reflecting a [liberating] approach to learning where [teacher and student collaborate] in problem solving and where teaching focuses more on the process of scientific inquiry than on the content of science," describe both the pedagogical foundation and the practical details of their work on "STRATEGIC SIMULATIONS," or software which creates an experimental universe in which students perform open-ended research. As an example of such a simulation, they describe the parameters and operation of the "Genetics Construction Kit."**

Karrer, Urs. "How to Develop Quality Courseware: Results of a Survey." Journal of Educational Technology Systems 16.4 (1988): 323-335.
Large Databases and Lab Data. **The author describes the results of a questionnaire designed to evaluate developers' views on the development of quality courseware. The results as analyzed demonstrate that developers see team-based production as more satisfactory than individual work and high level programming languages as state of the art, but the author found little agreement among the respondents as to which factors support the development under investigation.**

Kassirer, J. P., et al. "Toward a Theory of Clinical Expertise." American Journal of Medicine 73.August (1982): 251-259.
Problem-solving-based Learning. **The authors collect data on clinical reasoning from transcripts of verbalized problem solving. They believe that clarifying the problem-solving methods used by experts in clinical reasoning in this way will help students to learn the most useful tactics and strategies.**

Kinnear, Judith F. "Computer Simulation & Problem Solving in Genetics." American Educational Research Association. San Francisco, CA. 1986. 14 pp.
Simulation vs. Authentic. The author focuses on the use of computer-based problems in the study of genetics. She describes and compares textbook, laboratory, and computer-based genetics problems and explains how college students performed in completing and understanding computer-based problem-solving tasks. The study results suggest that computer-based problems can encourage productive rather than reproductive thinking and thus facilitate meaningful rather than rote learning of genetic concepts. The author argues that a computer-based presentation of problems confronts student misconceptions, identifies inadequacies in student problem-solving skills, and provides a productive context in which students can develop and refine their skills.

Knoppel, Curt, and Stephen Edelson. "'Critical Mass' and the Interactive Videodisc." Instruction Delivery Systems July/August 1988: 9-12.
Interactive Multimedia. The authors consider issues of hardware, delivery, and budget as they affect the development of the interactive videodisc and point out that the size of the potential customer base can make profitable even a disk that is expensive to produce. Public schools are, in their view, a prime "target" for videodisc sales. The article's several tables set forth the influence of usage patterns on the cost of hardware investment and of unit numbers on burden of disc production cost.

Kolner, Stuart, Prudence W. Dalrymple, and Richard Christiansen. "Teaching Skills in Medical Information Retrieval to Medical Students." Journal of Medical Education 61.Nov. (1986): 906-910.
Large Databases and Lab Data. The article notes that, while physicians increasingly depend on new information tools, such as computer databases and on-line literature searching, few medical schools have included more than token emphasis on information retrieval skills in their curricula. The authors here describe their attempt to devise an efficient and effective method of teaching medical students such skills: the method involves a self-paced individual learning module. They conclude that students who used their system module had significantly higher scores on a posttest than students who did not.

Kulik, James A., Robert L. Bangert, and George W. Williams. "Effects of Computer-Based Teaching On Secondary School Students." Journal of Educational Psychology 75.1 (1983): 19-26.
Research and Evaluations. Using quantitative techniques, or meta-analysis, to integrate findings from 51 independent evaluations of computer-based teaching in grades 6 through 12, this article showed that computer-based teaching raised students' scores on final examinations by approximately 32 standard deviations, or from the 50th to the 63rd percentile. Computer-based instruction also had smaller, positive effects on scores on follow-up examinations given to students several months after the completion of instruction. In addition, students who were taught on computers developed highly positive attitudes toward the computer and positive attitudes toward the courses they were taking. Finally, the computer reduced substantially the amount of time that students needed for learning.

Laurillard, Diana M. "Interactive Video and the Control of Learning." Educational Technology June 1984: 7-15.
Control Issues. The author conducted a feasibility study among students in an Open University course on living with technology, investigating the students' learning experience with interactive video. Her findings include a number of specific indicators of how students operate within a complex learning medium where they have significant control over the learning process. She concludes, "If interactive video were to become as highly controlling and directive as most [computer-aided learning] has been, it would

misuse the medium, partly because it diminishes the potential variations in the use of stored data and partly because it undermines the students' own responsibility for their learning. Giving the balance of control to the students [is both] more democratic [and] more educationally effective."

Ledley, R. S., and W. R. Ayers. "Computerized Medical Imaging and Graphics Evolves from Computerized Tomography." Computerized Medical Imaging and Graphics (formerly Computerized Radiology) 12 (1988): i-xviii.

Interactive multi-media. **Within the context of an explanation of changes in the journal's name and purview, its editors give detailed consideration to topics of computerized image handling in medicine on which the realigned publication will focus. These areas include digital image considerations, image acquisition methods, the storage and transmission of images, image processing and manipulation by computers, pattern recognition techniques, and image interpretation. The authors note the rapid development in the area overall as well as the exponentially increasing quantity of research and clinical results within the medical field which take advantage of the maturing technology.**

LeMon, Richard. "Binary Dragons: Issues Involving the Transfer of Computer Technology to the People's Republic of China." Journal of Educational Technology Systems 16.1 (1987): 3-7.

Human Factors. **The author outlines potential problems China will face as it incorporates computing into its national life. These include the language factor, the ill-educated generation of the Cultural Revolution, the extent to which knowledge of new technologies will create social gaps, and the potential incompatibility between Chinese cultural habit and the speed of computers.**

Lesgold, Alan, et al. "Expertise in a Complex Skill: Diagnosing X-ray Pictures." The Nature of Expertise. Ed. R. Glaser M. Chi. Hillsdale, NJ: Lawrence Erlbaum Assoc., 1988. Ch. 11.

Problem-solving-based Learning. **The authors present a progress report on their efforts to understand what constitutes radiological expertise and how that expertise is acquired. The goal is to understand the learning of a complex skill and thereby stretch the limits of knowledge about expertise and its acquisition.**

Levine, R.S., Harold Jones, and C. Morgan. "Comparison of Computer-assisted Learning with Tutorial Teaching in a Group of First-year Dental Students." Medical Education 21 (1987): 305-309.

Research and Evaluations. **The authors compared two identical groups of first-year dental students at the University of Manchester (Britain) learning about the pathology of dental caries and periodontitis using computer-assisted learning or tutorial teaching. In a cross-over arrangement, the first group was taught about dental caries by computer-assisted learning and periodontitis by tutorial teaching, and the second group in the reverse order. Comparison of the two methods included a knowledge test and completion of a questionnaire. Computer-assisted learning and tutorial teaching produced similar scores on the test. On the questionnaire, students indicated that they felt pressured with computer-assisted learning and had problems with note-taking. They liked a teacher to be present. Nevertheless, computer-assisted learning proved an acceptable method of instruction, conclude the authors, and more economical in terms of staff involvement than tutorial teaching.**

Liao, Thomas T. "Special Report: Advanced Educational Technology-A 5-year Program of the NATO Science Committee." Journal of Educational Technology Systems 18.1 (1989): 69-77.

Human Factors. The article gives a general overview of the types of sponsored activities of the NATO program mentioned in the title. Opportunities for collaboration among educational technologists, such as research workshops, advanced study institutes, and various scholarly visits, are sponsored in eight research and development categories, such as task analysis and expert systems, simulations, and tutorial strategies and learner control. The author gives general background and priorities for each of the categories.

Luehrmann, Arthur. "Technological Innovations in Higher Education: Are They Possible?" Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988. 8 pp.

Future/Effectiveness of Computer-assisted Instruction. The paper asserts that the failure to date to implement information technologies widely in university settings is a result of the lack, in the educational world, of those market forces which elsewhere lead to innovations that promote more efficient operation. The author suggests that the educator interested in working seriously with broadly-based teaching systems that rely on technology is likely to find a more congenial climate in military and industrial training than in the university.

Luskin, Bernard J. "CD: Compact Disc and Compact Data." Instruction Delivery Systems March/April 1988: 18-19.

Interactive multi-media. This article, which includes a list of example sizes of optical discs, aims to establish the concept that compact data may be formatted on any size disc and that consumers will see a variety of disc sizes as the various formats and standards emerge. The author notes that, unlike media transmitted through the airwaves, compact data has the potential for bringing closer together entertainment and education, the home and the school.

MacKnight, Carol, and Santosh Balagopalan. "Authoring Systems: Some Instructional Implications." Journal of Educational Technology Systems 17.2 (1988-89): 123-135.

Control Issues. The authors, computing professionals at the University of Massachusetts, review four systems for producing ("authoring") interactive courseware: Quest, PCD3, and IconAuthor, all operative on the IBM PC, and Course of Action for the Macintosh. They consider each in terms of its power, ease of use, and productivity and discuss the productivity aids of each system for graphics and logic, templating functions, and lesson testing, including menu and icon structures; detailed comparative charts accompany the discussion. Their conclusions: courseware with more graphics and less interaction and branching is more easily created with icon-based systems, while menu-based systems are preferable for the development of courseware with extensive control and branching as well as reasonably good graphics.

Mackowiak, Kate. "Deaf College Students and Computers: The Beneficial Effect of Experience on Attitudes." Journal of Educational Technology Systems 17.3 (1989): 219-229.

Cognitive Styles and Personality Types. The investigation detailed here examined the impact of individual differences on deaf college students' attitudes toward computers. Analysis of student-completed questionnaires revealed that computer experience positively influenced three components of computer attitudes: liking, anxiety, and confidence.

Magel, Mark. "Sailing through the Straits of Standards." AV Video June 1988: 40-43.

Interactive multi-media. **The author spells out the current standards for hardware which delivers interactive material, including analog videodiscs, digital compact disks and digital write-once, and erasable discs and cards. He points out that, with access to information on disc and on-line gaining exponentially in popularity, standards are essential to the success of the industry.**

Malaney, Gary, and Quint Thurman. "Student Opinions Regarding the Mandatory Use and Ownership of Personal Computers." Journal of Educational Technology Systems 17.4 (1989): 297-306.

Alternative Methods. **Some institutions of higher education have recently adopted policies requiring students to take computer courses and/or own personal computers, usually setting the requirements without input from students. This article describes a study in which Student Affairs Research and Evaluation Office at the University of Massachusetts at Amherst surveyed a random sample of 308 undergraduates by phone to analyze student opinion regarding such policies. The results show that students generally favor mandatory computer instruction but not mandatory computer ownership. Further, the findings suggest that students who see computer proficiency as a salient skill for future employment are more likely to favor both policies.**

Malaney, Gary D. "A Database for Monitoring Curricular Changes in Graduate Academic Departments." Journal of Educational Technology Systems 16.2 (1987-88): 111-120.

Control Issues. **This article discusses a database which was designed to improve the efficiency of a graduate school's records management process pertaining to establishing new courses and changing existing courses in graduate academic departments. The design of this database represents a step in an ongoing process to computerize all of the administrative activities at the graduate school of Ohio State University. The author describes the course approval process and the former record-keeping system, highlights the design and practical applications of the database, and discusses the on-line query process and the report writing features of the relational database package, emphasizing in conclusion the importance for academic planning of data which the system could provide.**

Marshall, Sandra P., et al. "Story Problem Solver: a Schema-Based System of Instruction." Office of Naval Research, Arlington, Va. BBB05183. San Diego State University Center for Research in Mathematics and Science Education. 1989. 38 pp.

Problem-solving-based Learning. **This report describes a computer-based instructional system, the Story Problem Solver (SPS), which provides students with instruction about the semantic structure of story problems. The schema theory underlying SPS, the design of SPS, and its operational features are described. An appendix summarizes one experimental study of the effects of sequential versus all-at-once presentation for evaluating specific design feature of SPS.**

McGhee, Robert B. et al. "Cost-effective Development of a Computer Assisted Instruction System." American Journal of Radiology 153.October (1989): 877-879.

Research and Evaluations. **The authors, who have designed a computer-assisted interactive system for radiologic education on the Commodore-Amiga microcomputer, argue that interactive tutorials such as theirs have many advantages as a learning method to augment other methods such as reading and lectures. They describe the development of the system, emphasizing its reasonable cost and noting that it is intended as a learning resource rather than a testing tool, and anecdotally discuss the generally positive responses of the students who have used it.**

McGuire, C.H. "Medical Problem-solving: a Critique of the Literature." Journal of Medical Education 60.August (1985): 587-95.

Problem-solving-based Learning. The author argues that the usual approach to descriptive studies of clinical reasoning, that of producing microscopic analyses of the verbal behavior of a person diagnosing a patient with symptoms of acute illness, has produced dubious conclusions and definitely fails to illuminate a large portion of the cognitive process involved in patient care. She further claims that the methodology offered by prescriptive, decision-analysis studies of medical problem-solving may not be one which decision-makers find attractive or feasible to use.

McLeod, Douglas B. "Technology and the Role of Affect in Teaching Mathematical Problem Solving." The 70th Annual Meeting of the American Educational Research Association. San Francisco, CA. 1986. 13 pp.

Kinds, Styles, Modes of Learning. The paper discusses the affective influences on students of problem solving instruction using computers, and the relationship of affective influences to student belief systems. It reviews affective issues and problem solving, then analyzes affect with particular reference to the work of G. Mandler. The paper considers types of cognitive processes, instructional environments and student belief systems. The issues are synthesized in a discussion on affect, computers, and problem solving, and implications for research are discussed.

McWhinnie, Harold J. "The Computer and the Right Side of the Brain." Journal of Educational Technology Systems 16.4 (1988): 343-348.

Kinds, Styles, Modes of Learning. This article presents a discussion of an artist's use of graphics software in terms both of right (intuitive) and left (analytical) sides of the brain. The author reviews the research literature in art education which shows the importance of the right brain in various areas of creative behavior and drawing skills and argues that while the computer has been shown as the *sine qua non* of conceptual and analytical thought processes, one can also approach computer-based creative work from a right brain perspective.

Milheim, William D. "Learner Control Options as an Effective Strategy." Instruction Delivery Systems September/October 1988: 4-6.

Control Issues. The author briefly describes three specific types of options which may be included in an interactive video program to give students control over their learning: pacing, sequence, and content control. He makes suggestions regarding the use of each and also includes a few general suggestions, such as the importance of using a prompt line to remind the learner how to use the controls that are available and the desirable design features of such a prompt line.

Miller, Dwight P., and Andrew C. Stone. "ProtoTymer: Human Performance Instrumentation for HyperCard Prototyping." Proceedings of the Human Factors Society 33rd Annual Meeting. 1989. 249-253.

Hypertext/Hypermedia. The article describes an application developed to collect interactive performance data, such as the times, locations, and targets of inputs during a session, from users of a hypertext application on Macintosh computers. The authors, who were involved in developing the application, see "ProtoTymer" as useful for evaluating the usability of prototypes for equipment and computer interfaces.

Moidu, Khalid, and Ove Wigertz. "Computer Based Information Systems in Primary Health Care-Why?" Journal of Medical Systems 13.2 (1989): 59-65.

Large Databases and Lab Data. The authors advocate emphasizing the values of enhanced information, rather than cost-benefit ratios, as the justification for using computer-based information systems in the health care field. Values mentioned include quality, quantity, availability, and accessibility of information, as well as the multiple

utility and ease of updating of a computerized database. They argue that integrated systems are superior to those dedicated solely to administrative or clinical records.

Molich, Rolf, and Jakob Nielsen. "Improving a Human-Computer Dialogue." Communications of the ACM 33.3 (1990): 338-348.
Human Factors. **The authors report on an exercise in interface evaluation which they gave to designers and programers from industry and academia. Results support their argument that designers and programmers often are not sufficiently attuned to the exacting requirements of good interface design, requirements which are "neither common knowledge nor intuitive." The article includes design guidelines.**

Morris, David C. "A Survey of Age and Attitudes Toward Computers." Journal of Educational Technology Systems 17.1 (1988): 73-78.
Kinds, Styles, Modes of Learning. **This study examines the relationships among age, education, sex, and household income, and attitudes toward computers as measured by an eight-item scale. Results indicate that younger, better-educated people have more positive attitudes toward computers than do older, less-educated people, with education influencing people's views more than age: sex and household income proved not to affect these attitudes significantly.**

Murray, Tom, et al. "An Analogy-based Computer Tutor for Remediating Physics Misconceptions. (Draft.)." FGK57295. National Science Foundation, Washington, D.C. 1988.
Cognitive Styles and Personality Types. **This paper evaluates the strengths and limitations of a computer tutor designed to help students understand physics concepts through a teaching strategy called "bridging analogies." The strategy is designed to remedy misconceptions by appealing to existing correct intuitions and extending these intuitions by encouraging analogical thinking. Results indicate that understanding of Newton's third law improved among most students using the tutor.**

Nielsen, Jakob. "Through Hypertext." Communications of the ACM 33.3 (1990): 298-310.
Hypertext/Hypermedia. **From a study of the usability of various hypertext interface design ideas, the author draws several conclusions of interest to educational designers: 1) it is important to conduct empirical usability testing, since real users will always interpret some aspects of an interface design in other ways than intended by the designer, 2) to help users navigate hyperspace, designers must devise methods for helping them understand and recognize their current location, and 3) a "backtrack" facility is an important navigation feature for novice users of hypertext systems.**

O'Connor, Richard J. "Integrating Optical Videodisc and CD/ROM Technology to Teach Art History." Journal of Educational Technology Systems 17.1 (1988): 27-33.
Interactive multi-media. **The study described here explores the feasibility of combining microcomputer-controlled videodisk instruction with large text-based data searching provided by CD ROM technology in an individualized instructional program in art history. The project described is intended to determine the practicality of repurposing generic videodisc and CD ROM programs through development of programming macros that can be used by teachers to individualize program content: the author sees this as one possible solution to the lack of funds and programming expertise which leads many teachers to use "off the shelf" software which does not meet their specific needs.**

Office of Technology Assessment, U. S. Congress. "Power On! New Tools for Teaching and Learning." Congress of the U.S. Washington, D.C. Office of Technology Assessment, BBB14214 (US Dept. of Education) (1988): 263 pp.

Future/Effectiveness of Computer-assisted Instruction. **This report on the potential of new interactive technologies for improving learning examines developments in the use of computer-based technologies, analyzes key trends in hardware and software development, evaluates the capability of technology to improve learning in many areas, and explores ways substantially to increase student access to technology. The role of the teacher, teachers' needs for training, and the impact of federal support for educational technology research and development are reviewed as well. Specific topics addressed include the adoption of computer and video technologies; evaluation research; computer-assisted instruction (CAI) and intelligent CAI; mathematics and science; multimedia programs; database management; word processing; language arts; electronic networks; cost-effectiveness; software; and research and development. The future of classroom instruction is discussed in terms of networking and distance education, CD-ROM and computer/video convergence, hypermedia, integrated learning systems, and videodisks. Appended materials include a summary of state activities in educational technology; criteria used to evaluate educational software; principal programs of the U.S. Department of Education that are providing funds for technology in education; a list of acronyms; and a bibliography of contractor reports. Also included are a copy of the September 1988 OTA Report Brief entitled "Power On! New Tools for Teaching and Learning," and a September 15, 1988 Press Release announcing two videotapes on the influence and potential of educational technology in public schools, now available from SL Publications, New York.**

Olenick, Richard P. "The Development of Video Tapes for High School Physics Courses: The Mechanical Universe and Beyond." Journal of Educational Technology Systems 17.1 (1988): 33-46.

Interactive multi-media. **The author narrates the development and effectiveness of the videotapes for secondary physics instruction of which he was the project director. He describes the methods used by high school physics teachers to create the tapes, adaptations of the college level PBS series *The Mechanical Universe*, and supporting teaching materials, and goes on to review the results obtained when 100 teachers and 3000 students nationwide used the modules. Among the favorable conclusions reported: students who used the videotapes judged concepts presented visually as easier to understand.**

Olson, Michael J. "The Expert Media Systems." Journal of Interactive Instruction Development Summer 1989: 3-10.

Interactive multi-media. **The article describes EMS, an aid for professional instructional designers and course developers in making cost-effective media and strategy selection decisions based on the nature of the learning task. Users' answers to questions enable the system to "understand" the nature of each task. It then performs expert analyses of the input combined with its large knowledge base and provides a summary of the learning task analysis, a list of media in order of appropriateness, and a selection of media which offer the best cost-benefit ratios. The author was involved in developing the system.**

Palmer, Caroline. "Understanding Music Performance with Graphical Aids." Alfred P. Sloan Foundation Invitational Conference. A Critical Examination of Technology in Higher Education with a Special Focus on the Issue of Using Real World Information. Dartmouth College, Hanover, NH. 1988.

Alternative Methods. **A primary problem for theories of skilled music performance is to account for performed variations from what is written in music notation. In this paper, the author describes graphical and statistical applications to piano performance that allow examination of musical expressiveness. The system, controlled by a Sun workstation, displays performances in the form of a piano roll shown on its side, with time and pitch moving on the two axes. With advantages that include flexibility and the potential for displaying simultaneous sources of information, the graphical**

performance has educational advantages for the novice and skilled performer, aiding in developing models of skilled musical performance.

Parrish, Kevin L. "Megacode: An Example of Vieodisc Design for the Medical Professional." Journal of Interactive Instruction Development .Summer 1989: 19-20.
Interactive multi-media. The author, after noting that interactive video is increasing in popularity within the medial profession as a cost-effective training method, illustrates the design, development, and marketing issues that contribute to the production of successful videos for medical training by describing a product for CPR training. He concludes that successful medical training videos will have good instructional design and accurate content and will be made with sensitivity to the expectations of the medical audience.

Patel, Vimla L., D. A. Evans, and D. R. Kaufman. "Reasoning Strategies and the Use of Biomedical Knowledge by Medical Students." Medical Education 24 (1990): 129-136.
Problem-solving-based Learning. An experiment was designed to investigate the use of biomedical information in the explanation of a clinical problem without any basic science information and where basic science information was provided after the clinical case. The authors claim that, with the exception of final-year medical students, the use of biomedical information interfered with the data-driven reasoning, although it did help predictive reasoning. They argue that a sound disease classification scheme is needed before biomedical knowledge can facilitate both data-driven and predictive reasoning during clinical problem-solving.

Paulanka, Betty J. "The Learning Characteristics of Nursing Students and Computer Assisted Instruction." Computers in Nursing 4.6 (1986): 246-254.
Cognitive Styles and Personality Types. This article, which includes a review of the literature, describes an experiment aiming to relate the backgrounds, attitudes, and time constraints of nursing students to their learning outcomes. While acknowledging that few clear trends emerged, the authors include among their recommendations guidelines for planners of computer-assisted instruction and for designers of instructional software.

Peterson, Nils S., et al. "A Pedagogical Challenge: Integrative Thinking." National Institute of Education. 1985.
Problem-solving-based Learning. This article concerns an instructional framework which provides opportunities for students to synthesize knowledge and recognize general approaches to problem representation and solution. The authors emphasize the need to combine an interdisciplinary approach with new technologies. Among the major ideas addressed: the role of the computer in teaching about complexity and the new professional activity of knowledge interface design. The authors suggest, indeed, that this new activity should be the function of a new professional group, knowledge designers, who will lead the movement toward curricular revisions that will bring in a new era of integrative thinking.

Pickell, G.C. et al. "Computerized Clinical Patient Problems: an Evolving Tool for Medical Education." Medical Education 20 (1986): 201-203.
Simulation vs. Authentic. The author, who works in medical education, describes a a computer-based simulator of patient cases. The simulation system, which runs on the IBM PC, is flexible, portable, and responsive to individual student needs: it does not require computer literacy. With a design based on the principles of problem-based self-directed learning, the author argues, the simulation is useful in individual and group learning and evaluation of data management and clinical reasoning skills.

Pollak, Richard A. "Generic Videodiscs in Education and Training." Instruction Delivery Systems May/June 1989: 22.

Research and Evaluations. **This brief article consists principally of statistical information demonstrating the exponential increase in the number of videodiscs being used in "non-consumer" areas during the last few years. The author, president of a consulting company which published a compendium of available education and training videodiscs, cites science and art as the subject areas in which the production of videodiscs is growing most rapidly.**

Rabinowitz, Howard K. "Expansion of the Modified Essay Question into an Audiovisual Format." Journal of Medical Education 60.November (1985): 883-885.

Tests and Evaluation Methodology. **The author, a professor of family medicine at Jefferson Medical College in Philadelphia, used audiovisual presentations of simulated patient problems with medical students, with interruptions during which the students were asked to give written response to questions about appropriate treatment. He found it likely that this audiovisual amplification of the modified essay question not only supplies comprehensive immediate feedback but has greater potential for measuring attitudinal and judgmental qualities than do traditional examination questions.**

Reglin, Gary. "CAI Effects on Mathematics Achievement and Academic Self-Concept Seminar." Journal of Educational Technology Systems 18.1 (1989): 43-48.

Alternative Methods. **The author describes his study on the effects of computer-assisted instruction in a seminar on mathematics skills given for admission to teacher education programs at historically black South Carolina State College. During the investigation, he saw the computer-assisted instruction increase both mathematics and academic self-concept scores, especially for low socioeconomic-status students. He concludes that computer-assisted instruction, which is private, patient, and bias-free, provides an excellent vehicle for students to improve their academic self-concepts.**

Rich, Elaine. "Users Are Individuals: Individualizing User Models." International Journal of Man-Machine Studies 18 (1983): 199-214.

Kinds, Styles, Modes of Learning. **The author sets forth, in the context of a discussion of "user models," the potential of the computer to tailor the tools used for a task not merely to the characteristics of the typical user, but to fit them to the individual user. It has long been recognized that in order to build a good system in which a person and a machine cooperate to perform a task it is important to take into account some significant characteristics of people. these characteristics are used to build some kind of a user model. Traditionally the model that is built is a model of a typical user. But often individuals vary so much that a model of a typical user is insufficient. Instead, models of individual users are necessary. This article presents some examples of situations in which individual user models are important. It also presents some techniques that make the construction and use of such models possible. These techniques all reflect a desire to place most of the burden of constructing the models on the system rather than on the user. This leads to the development of models that are collections of good guesses about the user. thus some kind of probabilistic reasoning is necessary. And as the models are being used to guide the underlying system, they must also be monitored and updated as suggested by the interactions between the user and the system. The performance of one system that uses some of these techniques is discussed.**

Rigby, P. G. "The Future of Medical Education." American Journal of Obstetrics and Gynecology 156.6 (1987): 1389-1394.

Human Factors. **The article presents a speculative overview of medical education in the 21st century: one of seven central assumptions is that networking will be the primary means of contact for faculty, students, and administration, promoting a decentralized organizational structure and function. There is a 17-item suggested reading list.**

Rowland, Paul, and Carol L. Stuessy. "Effects of Modes of Computer-Assisted Instruction Conceptual Understanding and Achievement of College Students Exhibiting Individual Differences in Learning: A Pilot Study." Annual Meeting of the National. Association for Research in Science Teaching. Washington, DC. 1987.

Cognitive Styles and Personality Types. **The purpose of this study was to determine the effects of two modes of computer-assisted instruction, simulation and tutorial, upon the ability of college students with various learning styles to understand relationships among concepts. While findings showed that using the tutorial tended to raise achievement scores, the ability to relate the concepts did not change depending on the mode used. There is a 27-item bibliography.**

Rubin, Andee. "Contributions of Cognitive Science and Educational Technology to Training in Radiology." Investigative Radiology 24.9 (1989): 729-732.

Cognitive Styles and Personality Types. In the context of a discussion of the theory behind current radiology education, the article describes a joint project of Bolt Beranek and Newman, Inc. (the author's company) and Harvard Medical School. The project involves the use of a large set of examples of mammographic cases, stored on CD/ROM, along with a system which selects tasks appropriate to the user's current state of expertise, as a training device for residents in radiology and practicing radiologists.

Saba, Farhad, and David Twitchell. "Integrated Services Digital Networks: How It Can Be Used for Distance Education." Journal of Educational Technology Systems 17.1 (1988): 15-26.

Large Databases and Lab Data. The networks of the title will, the author argues, depend for appropriate use on the development of a conceptual scheme to integrate models from several closely related areas such as integrated information systems, educational broadcasting, computer assisted instruction, and distance education. In this article, the author describes ISDN (an integrated voice, data, and image transmission system using standard telephone interfaces), shows how workstations facilitate its use, and suggests ways of shaping its use for educational purposes.

Sasscer, Monica F., and David M. Moore. "A Study of the Relationship Between Learner-Control Patterns and Course Completion in Computer-Assisted Instruction." PLET 21.1 (1984): 28-33.

Control Issues. The authors studied English grammar and Algebra I students at Northern Virginia Community College to determine how such students used the available learner-control features of the Time-Shared Interactive Computer-Controller Information Television (TICCIT), a time-shared instruction system using color video, computer-generated displays, and audio messages. The study involved keeping a log tape record of the keypresses made by the subjects as they progressed through the lessons. An analysis of the keypresses resulted in the classification of nine different strategy patterns. The findings included these: 1) the students did make use of the learner-control options to develop learning strategies but did not seem to use any one pattern consistently throughout the lesson, and 2) students in the English course used patterns which included examples more frequently, while students in algebra used rules and practice patterns more frequently. The authors conclude with suggestions for courseware designers based on their findings.

Schell, George P. "A Primer for Problem Solving Using Artificial Intelligence." Journal of Educational Technology Systems 16.4 (1988): 365-382.

Problem-solving-based Learning. Artificial intelligence has recently elicited wide interest within and beyond academia, the author avers: the prospect of creating machines that " think" strikes at the heart of what most people believe is uniquely human. With the proper understanding of what reasoning is and how knowledge is represented and manipulated, engineers can make a system that mechanically answers questions in a manner which would, if performed by a human, be considered "intelligent." For the benefit of those researchers in various fields who desire some understanding of the concepts and principles upon which artificial intelligence is founded but do not require in-depth knowledge, this article presents some of the systems that initiated it and demonstrates the principles of its major methodologies. An accompanying table lists sources of information on artificial intelligence.

Schloss, Patrick J. et al. "Effectiveness of Computer-Assisted Special Education Administration Simulations." Journal of Special Education 20.4 (1987): 503-13.
Simulation vs. Authentic. The authors review recent literature indicating that computer-assisted instruction simulations may enhance motivation, support the transfer of knowledge and skills, and increase instructional efficiency. They then describe a study at Pennsylvania State University evaluating these assumptions by using special education administration simulations with high- and low-achieving college students. Significant differences were not obtained in a contrast between the standard objective question module and the simulation module, either for items taken directly from the modules or for generalization items. In addition, use of a student opinion survey indicated that participants favored the standard objective question module. Finally, students required substantially more time to complete the simulation module. As in previous investigations, high-achieving students learned more than low-achieving students, regardless of the nature of the module. Acknowledging that their study raises more questions than it answers, the authors discuss the results with reference to alternative computer-assisted simulation designs that may support the original assumptions.

Schloss, Patrick J. et al. "The Influence of Error Correction Procedures and Question Type on Student Achievement in Computer Assisted Instruction." Journal of Educational Technology Systems 16.1 (1987): 17-27.
Research and Evaluations. Noting that recent research investigating the effectiveness of computer assisted instruction has shown that increasing the ratio of cognitive to factual questions may not, in and of itself, influence student achievement, the authors present their study of analyses of variance designed to determine whether question type and/or error response differentially affected subsequent responses to factual and higher cognitive questions. The results indicated that higher cognitive questions in these computer-assisted lessons produced no greater learning than did of factual questions. Indeed, simply allowing a student to try again was superior to re-presenting content for the factual question modules.

Schulze, Kay G. "The Use of Multiple Explanations in an Open-ended Intelligent Tutoring System." Journal of Educational Technology Systems 18.3 (1990): 235-243.
Alternative Methods. Noting that the development of intelligent tutoring systems has included considerable effort in attempting to represent knowledge adequately, in modeling the students' problem-solving behavior, and in diagnosing students errors, the author describes a research effort aimed at providing students with multiple explanations of how to solve problems. PRECEPTOR, an open-ended tutorial system designed to teach students how to generate equations involving two variables from an algebraic word problem, tutors students individually by determining which of two tutoring strategies is most effective and providing varied levels of tutoring appropriate to the four difficulty levels for each class of problems. The system, based upon the

premise that multiple explanations are necessary to model an effective teacher, was still being analyzed for effectiveness when the article appeared.

Seidman, Robert H. "Knowledge Intensive Programming: a New Educational Computing Environment." Journal of Educational Technology Systems 18.3 (1990): 207-214.
Alternative Methods. The author explores the possible advantages of a recently developed knowledge-intensive computational environment and computer programming language paradigm, Prolog, as an alternative to traditional educational computing procedural programming environments and languages. He concludes that the "potential applications, implications, and consequences of Prolog [and of logic programming in general] offer a multitude of challenges and opportunities for the educational computing research and practitioner communities.

Sellers, E. M. "Putting Computers to Work for Curriculum Planners - a Symposium." Research in Medical Education Annual Conference. 1985.
Large Databases and Lab Data. At this symposium, three medical school staff members outlined the use of computers for the delivery of course information at their institutions. Sellers of the University of Toronto described the use there of the Oracle system, a relational database of courseware materials. Ronan of New York's Mt. Sinai Medical School described a pair of linked databases which permits the answering of inquiries about the curriculum and the syllabus. Mattern of UNC Chapel Hill explained the ongoing development of a computerized database for the preclinical curriculum. All are skeletal at the present in relation to what their proponents envision as future potential of such systems.

Shannon, J. D. "Small-group Interactive Computer-assisted Teaching." Medical Education 24 (1990): 148-150.
Alternative Methods. The article describes a method of teaching small groups of medical students (four or five per group) at the Montreal General Hospital utilizing a tutor and computer assistance. The major supposition of the paper is that constant interaction on a question-and-answer basis is the most efficient form of teaching. With this method, instructors can easily and rapidly identify areas of weakness and lack of comprehension of concepts. Patient management problems on the computer supply the questions that constitute the basis of the tutorial, allowing a more comprehensive case exposure than is possible using hospitalized patients. Tutors may then expand upon these questions from personal experience.

Sharma, Sarla. "Learners' Cognitive Styles and Psychological Types as Intervening Variables Influencing Performance in Computer Science Courses." Journal of Educational Technology Systems 15.4 (1987): 391-399.
Cognitive Styles and Personality Types. The author, who states that the problems of identifying components of computer science aptitude and predicting academic success in computer science courses become increasingly important as the demand for computer science courses increases, reviews recent research studies on computer learning, in particular on the relations between computer learning and cognitive styles.

Sheingold, Karen, Janet H. Kane, and Mari E. Endreweit. "Microcomputer Use in Schools: Developing a Research Agenda." Harvard Educational Review 53.4 (1983): 412-432.
Research and Evaluations. Based upon their report of a study of the ways in which different school systems used microcomputers for instruction, the authors develop an agenda for future research. They investigated three geographically distinct school districts with diverse microcomputer applications at both elementary and secondary levels. Important questions for future study emerged in these areas: access to microcomputers, emergence of new roles in response to microcomputers, integration of

microcomputers into elementary classrooms and curricula; quantity and quality of software; preparation of teachers for using microcomputers; and effects and outcomes of the instructional use of microcomputers.

Shlechter, Theodore M. "An Examination of the Research Evidence for Computer-based Instruction." Advances in Human-Computer Interaction. Ed. H. Rex Hartson and Deborah Hix. Norwood, NJ: Ablex Publishing Corp., 1988. 2: 316-367.

Research and Evaluations. **This chapter sets forth the conclusions of a member of the US Army Research Institute on the research evidence for the efficacy of computers in instruction. His conclusions: empirical support does not exist for the claimed advantages of computer-based instruction over other instructional media because, among other reasons, problematic research practices pervade the literature, with media effects often confounded with extraneous treatment effects. He offers suggestions for design, advocating that instructional designers use the latest findings of psychological research. Computer-based instruction, he argues, is most useful for enabling students to have training experiences which are difficult to arrange or to monitor in the classroom. The author concludes by stating his conviction that research and evaluation of student-computer interaction is essential at every step of the development and implementation process if significant advances are to occur in computer-based instruction. There is a 162-item reference list.**

Shute, Valerie, and Jeffrey Bonar. "Intelligent Tutoring Systems for Scientific Inquiry Skills." EDN00001. IS RIEFEB89. National Institute of Education. 1986.

Cognitive Styles and Personality Types. **The article describes initial prototypes of systems designed to build students' scientific inquiry skills, skills taught in the context of acquiring knowledge of principles from a microworld that models a specific domain. In the prototypes, microworlds have been implemented for microeconomics, electricity, and light refraction. Working with microworlds, the authors/designers argue, enables students to "do science" without the complications of laboratory work in the real world.**

Siegel, J. D., and T. A. Parrino. "Computerized Diagnosis: Implications for Clinical Education." Medical Education 22 (1988): 47-54.

Problem-solving-based Learning. **The authors hold that the success of computerized medical diagnosis will be determined largely by the quality of the information that clinicians provide for analysis. They briefly review the status of bedside diagnosis and say that data-gathering strategies and techniques must be better understood. They argue for emphasizing basic diagnostic skills more heavily in clinical training.**

Sleeman, D. "Intelligent Tutoring Systems: A Review." ERIC: #ED 257 450 IR 011 683. Stanford University. 1984.

Cognitive Styles and Personality Types. **This paper presents a critical review of computer assisted instruction; an overview of recent intelligent tutoring systems (that is, computer-assisted systems which recognize the student's individual characteristics and modify instruction accordingly), including current shortcomings; major activities of the field, such as extending and developing artificial intelligence techniques for use in intelligent tutoring systems; and a methodology for building intelligent tutoring systems. The author takes supporting examples from his own work toward an intelligent tutoring system for algebra. He suggests a research agenda for intelligent tutoring system development relating to current activities in artificial intelligence and appends a list of 36 references.**

Small, Parker A. "Consequences for Medical Education of Problem-solving in Science and Medicine." Journal of Medical Education 63 (1988): 849-853.

Problem-solving-based Learning. **The author argues that medical education must emphasize the ability to make an association between some external stimulus or situation and concepts stored in memory. Two teaching methods which aid in this "wait time" and "concept mapping" are reviewed.**

Smith, Karen E. "Hypertext-Linking to the Future." ONLINE March 1988: 32-40.

Hypertext/Hypermedia. **The article presents an overview of hypertext and hypermedia and then describes the Intermedia system developed at Brown University, giving special attention to the on-screen maps which allow Intermedia users to visualize the way in which the information is linked together. The conclusion explores possibilities for hypertext in conjunction with online databases. There is a sidebar, "Information Retrieval in the Humanities Using HyperText," by Susan Kinnell, and a list of 7 references.**

Soloway, Elliot, Beth Adelson, and Kate Ehrlich. "Knowledge and Processes in the Comprehension of Computer Programs." The Nature of Expertise. Ed. M. Chi, R. Glaser and M. Farr. Hillsdale, NJ: Lawrence Erlbaum Assoc., 1988. 129-152.

Cognitive Styles and Personality Types. **The essay describes an experiment devised by the authors, the results of which demonstrate that programmers have and use specific programming plans and rules of programming discourse in the process of comprehending computer programs. They judge this finding of interest to considerations of software engineering and of the learning process in general.**

Steinhaus, Kurt A. Learning Auditory Discrimination with Computer Assisted Instruction: a Comparison of Two Different Performance Objectives. Eastern New Mexico University, 1981.

Alternative Methods. **The author of this master's thesis studied two groups of college freshmen music majors to determine which group demonstrated greater achievement in learning auditory discrimination using computer-assisted instruction. A treatment of specifically defined objectives was administered to an experimental group; the control group was directed to continue to improve. Statistical analysis revealed gains in music achievement for both groups, with no significant difference between the two. The author concludes that, although the study showed computer-assisted instruction to be a valuable supplement to student learning of auditory discrimination, different types of objectives and different ways of administering objectives should be considered in future studies. He appends supporting data, tests and forms used during the study, and an extensive bibliography.**

Stern, Claire M. "Teaching the Distance Learner Using New Technology." Journal of Educational Technology Systems 15.4 (1987): 407-418.

Alternative Methods. **Distance learners may be professionals requiring upgraded skills in science and engineering or displaced workers unaccustomed or lacking access to a traditional classroom. For such people, flexible opportunities for returning to school are now a necessity if they are to compete successfully in a complex information-based society. The author describes the history and current state of existing distance-learning programs, most video-based, offered through the Pennsylvania State University, the State University of New York, Quincy (Massachusetts) Junior College, and school districts in Minnesota and California, and continuing-education programs for corporate employees through the "Satellite University" of the National Technological University initiated by 16 Fortune 500 companies. She concludes that, after years of pilot programs and focus on the technological end, the time has arrived for greater focus on the users and for faculty members to learn more about the techniques of distance teaching.**

Stevens, Ronald H., Anthony R. Kwak, and J. Michael McCoy. "Evaluating Preclinical Medical Students by Using Computer-based Problem Solving Examinations." Academic Medicine 64.11 (1989): 685-687.
Tests and Evaluation Methodology. **The UCLA study described here aimed to determine the feasibility of creating and administering computer-based problem-solving examinations for evaluating second-year medical students in immunology and to determine how students would perform on these tests relative to their performances on other types of concurrently administered examinations. The examination questions require students to diagnose cases on the basis of information contained in the software by selecting and reviewing lab test data in graphic form and by reviewing a patient case history. The goal is to reduce the emphasis on acquiring large numbers of facts and to promote problem-solving skills. The results indicate that correct solution of the problems correlates with the early selection of the most relevant data.**

Strauss, Roy. "Don't Think 'Video' First When Considering Videodisc." Instruction Delivery Systems July/Aug (1988): 6-8.
Interactive multi-media. The author suggests that developers of interactive videodiscs regard the medium not as television-based but as computer-based, using a videodisc player as a peripheral device. Adopting this viewpoint will allow developers to look to computer software designers and programmers for design solutions.

Templeton, Alexander C. "Videodisc - Computer Technology in the Teaching of Pathology." The Physiologist 28.5 (1985): 432-434.
Research and Evaluations. The author, who teaches pathology at Chicago's Rush Medical College, sets forth the five desired outcomes of pathology instruction for medical students and then examines possible methods of computerized instruction suitable for each outcome. His conclusion: computerized lessons are appropriate for teaching vocabulary and the use of clinical lab tests (by means of simulations), but not cost-effective for the other aspects of pathology instruction given the large start-up costs.

Tennyson, Robert D. "Use of Adaptive Information for Advisement in Learning Concepts and Rules Using Computer-assisted Instruction." American Educational Research Journal 18.4 (1981): 425-38.
Interactive multi-media. The author uses the findings from two experiments with high-school students of physics and English grammar to show that students can effectively manage their learning needs in a computer-assisted instructional system when they are provided with continuous, updated information about their achievement and instructional needs in relation to the objective. He reviews the relevant literature and includes a reference list.

Thomas, Barbara. "Development of an Instrument to Assess Attitudes toward Computing in Nursing." Computers in Nursing 6.3 (1988): 122-127.
Cognitive Styles and Personality Types. The author describes a project developing two parallel forms of an instrument to measure attitudes toward computing in nursing, to be used before and after computer literacy programs, with a view toward the promotion of positive attitudes.

Thompson, Merton E. "Individualizing Instruction with Microcomputer Produced Text." The Annual Meeting of the Association for Educational Communications and Technology. New Orleans, LA. 1988.
Cognitive Styles and Personality Types. This paper proposes a method for studying the effect of an individual difference variable – field dependence-independence in learners –on the ability of a student to read and understand text information on a computer screen. The author hypothesizes that field-dependent students will learn more quickly from text with headings, field-independent learners from text without headings. He

presents a literature review and detailed hypotheses, but not his findings. There is a 15-item reference list.

Thomson, Douglas R. "Transfer of Training from Simulators to Operational Equipment-Are Simulators Effective?" Journal of Educational Technology Systems 17.3 (1989): 213-218.
Simulation vs. Authentic. The author, whose special interest is in military training, notes that recent advances in computers and their capabilities have made possible the development of sophisticated simulators, training devices which attempt to reproduce or simulate the essential characteristics of a "real" system. In this article, he examines the degree of fidelity required of the simulation to ensure maximum transfer of training. Simulator use, the author states, has been extremely effective in the training of military personnel, and research indications are that the degree of fidelity required for effective simulator training varies according to the task.

Tsai, Chia-jer. "Hypertext: Technology, Applications, and Research Issues." Journal of Educational Technology Systems 17.1 (1989): 3-14.
Hypertext/Hypermedia. The article reviews the historical development and technological features of hypertext. Three areas of application are identified: (1) instruction, (2) electronic publishing and online databases, and (3) thinking and authoring tools. The author also discusses research issues in document processing and education, concluding that hypertext's unparalleled potential cannot be fulfilled before research in "human sciences" answers some of theoretical questions it raises. There are 28 references.

Tucker, Marc S., Ed. "Computers on Campus: Working Papers." Current Issues in Higher Education n. 2 1983: 2-43.
Future/Effectiveness of Computer-assisted Instruction. The issue of *Current Issues in Higher Education* summarizes developments in instructional computing projects, many mainframe-based, at the time of its publication. Developments at Carnegie-Mellon University, Brown University, and the Massachusetts Institute of Technology, which all have large investments in information technology, comprise the first section. The second section describes instructional computing projects targeted to specific instructional purposes at the University of Maryland, Colorado State University, the University of Illinois, and the Milwaukee Area Technical College.

Turkle, Sherry. "The Human Spirit in a Computer Culture." The Second Self: Computers and the Human Spirit. New York: Simon and Schuster, 1984. 306-313.
Human Factors. Drawing upon observations of children and computers, the author argues that computer culture is leading people to a revolutionary new way of regarding themselves in relation to other entities. As Copernicus' discoveries led to the realization that the earth was not the center of the universe, so the pervasiveness of computers in society is leading to the recognition that higher-level mental processes are not, or are no longer, confined exclusively to human beings.

Van Dam, Andries. "Hypertext '87 Keynote Address." Communications of the ACM 31.7 (1988): 887-895.
Hypertext/Hypermedia. The talk transcribed here is a personal perspective of hypertext applications of one long involved in their development. After tracing the concept's development, he summarizes various areas of current concern for those interested in hypertext: user-controlled 3D animation, standards across applications, issues of size, navigation problems, design control, matters of accessibility and portability, and sociopolitical and economic problems including as yet unresolved issues of intellectual property rights and compensation.

Verbeek, H.A. " Self-instruction through Patient Simulation by Computer." Medical Education 21.1 (1987): 10-14.

Simulation vs. Authentic. The author of this paper begins by reviewing the evolution of medical education from a disease-based to a problem-based model and outlining the move away from lecture and toward the necessity for interactivity which the new model brought about. He goes on to describe a system of interactive teaching of medical students in patient management by using a computer simulation of patients' cases, which allows students to take some of the steps doctors take in making decisions – data collection, diagnosis based on collected data, and choice of treatment – and which returns a comment to the student, analyzing in detail his or her skill in diagnosis.

Wallace, Squy G., and Paul Sheffield. "From Task Analysis to Lesson Plans: an Application of Computer Macros." Journal of Educational Technology Systems 16.1 (1987): 57-64.

Large Databases and Lab Data. Application of the instructional system development model to large scale projects has frequently been criticized for failing to develop and deliver training materials in a timely manner. This article suggests that the use of a computer-generated graphic portrayal of task analysis data and the use of computer macros can provide some insight into the question of how technicians perform tasks and streamline the training development process.

Watson, J. Allen, Michelle Eichhorn, and John Scanzoni. "A Home/University Computer Network: Test of a System to Study Families." Journal of Educational Technology Systems 17.4 (1989): 319-335.

Alternative Methods. The authors designed a computer-based research model to study the decision-making processes of families, tested the model over a two-months period, and then compared the reliability and validity of the system in relation to the traditional research methods within the discipline, interviews and surveys. Their data suggests that this integration of an existing family process conceptual model and the microcomputer-mainframe system could be used as a new research paradigm and that the paradigm proved to highly reliable and valid: they conclude that it is both possible and practical to perform home-university computer-networked research.

Weiner, Elizabeth et al. "Interactive Videodisc Production in a University Environment." Computers in Nursing 6.3 (1988): 108-114.

Interactive multi-media. The article describes production of a videodisc about nursing care of diabetic patients. The authors present information about their experiences with various components of the production, including design considerations, video production, editing and mastering, programming and interfacing, and marketing issues. They include a budget table and lists of concise suggestions for team development, hardware/software, video production, and video editing. One area of emphasis: the cost saving of not using a graphics overlay board.

West, Scott A. "Medical Education and the Role of Computers-as Seen through the Eyes of a Medical Student." Journal of Medical Systems 13.5 (1989): 237-239.

Human Factors. After summarizing the problem of the exponentially expanding knowledge base in medicine and the unchanged memory capacity of medical students, a fourth-year medical student describes an experiment comparing the diagnoses of a simulated case produced first by using memory and then by searching a online medical database. The initial differential diagnosis generated by memory was approximately 1/5 of that generated by computer. The author concludes that desperately needed revisions of the medical education system should include increased training in the sophisticated use of such tools.

Wetzel, Mary C. "Process Video in Scientific Higher Education." Journal of Educational Technology Systems 16.3 (1988): 265-281.
Interactive multi-media. **The author describes video-assisted teaching techniques which emphasize three-way interactions among instructors, students, and video machinery. She shows how simple video assistance was introduced and developed gradually into more fully instrumented learning environments, with examples taken from a variety of experimental classrooms. Her conclusion is that a science of learning which merges video and computer science can help to integrate research, teaching, and service functions of postsecondary institutions. There are 24 references.**

White, Charles S. "Computers in Social Studies Classrooms." ERIC Digest EDO-SO88-5. (1988): 4 pp.
Alternative Methods. **This ERIC Digest summarizes ways in which computers are used in the social studies classroom, the current state of knowledge about the effects of computer use on teaching and learning in social studies, and the trends likely to develop in the use of computers in social studies education. In the last area, he notes that the importance of computers in schools depends more on their usefulness to teachers than to students, that development will focus on databases as a facilitator of the development of thinking skills, that more fully integrated software will move students through simulated social microworlds, that interactive video will expand as a delivery vehicle as its cost declines, and that hypermedia systems will become increasingly important in allowing educators to represent and students to explore complex networks of data.**

Wigton, Robert S. "The Use of Computer Simulation in Teaching Clinical Diagnosis." Computing Methods and Programs in Biomedicine 25.2 (1987): 111-114.
Simulation vs. Authentic. **The author notes that previous studies have shown that feedback of the weighting used in making complex judgments can greatly improve learning when the correct weighting is known. In this paper, he describes a microcomputer program he developed which calculates and displays factor weighting based on answers to clinical case simulations. In one application, students learning to diagnose urinary tract infusion with computer feedback of weighting progressed more rapidly than a control group who received outcome feedback alone. Other applications in the clinical setting suggest that this type of learning can improve diagnostic accuracy and predictive calibrations through more accurate assimilation of the clinical information available.**

Winkle, L.W., and W.M. Mathews. "Computer Equity Comes of Age." Phi Delta Kappan January 1982: 314-315.
Cognitive Styles and Personality Types. **The authors point out the importance of equal access to the benefits of the computer age if all students – male and female – are to achieve computer literacy. As steps toward this end, they recommend enhancing the self-concept of girls concerning computer technology, providing computer literacy as a survival skill to elementary children, and enhancing computer equity through expanded career goals for girls.**

Wollenberg, J.P , H.M. Handley and J.R. Enochs. "Differences in Achievement with Computer Assisted Instructions: Implication for Varying Student Learning Styles." Educational Technology 1985: 51-52.
Kinds, Styles, Modes of Learning. **After setting forth the instructionally important differences between computer assisted instruction groups and more traditional self-paced instructional groups and between concrete and abstract learners, the authors recommend the compilation of a computerized student data bank for the construction of student learning style profiles.**

Woodward, John, Douglas Carnine, and Russell Gersten. "Teaching Problem Solving through Computer Simulations." American Educational Research Journal 25.1 (1988): 72-86.
Problem-solving-based Learning. **This study involved 30 mildly handicapped students who were divided between a group which featured structured teaching and another group which had a combination of structured teaching and a computer simulation. Results showed that the combination including the computer simulation was effective in teaching not only factual-level knowledge, but also higher cognitive skills.**

Woolf, S. H., and D. A. Benson. "The Medical Information Needs of Internists and Pediatricians at an Academic Medical Center." Bulletin of the Medical Library Association 77.4 (1989): 372-380.
Kinds, Styles, Modes of Learning. **This article details the results of a study about what kinds of medical information how doctors at Johns Hopkins need and how they get it. The study showed that the types of information needed most frequently were treatment recommendations and differential diagnosis and that the doctors surveyed most commonly used textbooks and colleagues as reference sources. The authors discuss the importance of a broad understanding of physician information needs through improved data collection techniques as a means of increasing the use of medical information systems.**

Wu, Chih. "New Age of Satellite Education." Journal of Educational Technology Systems 16.3 (1988): 231-238.
Human Factors . **The author discusses the potential of satellite technology for long-distance education, especially in teaching Chinese to people in other nations and to overseas Chinese. He suggests organizational steps toward realizing the potential of the technology for Chinese, both within China and in other countries. Such steps would require technical and financial support from more developed countries, he recognizes.**

Yankelovich, Nicole. "Intermedia: a System for Linking Multimedia Documents. IRIS Technical Report 86-2." BBB24928. Brown Univ. Providence, RI. Institute for Research in Information and Scholarship. 1986.
Hypertext / Hypermedia. **This paper discusses hypermedia systems in general and then describes Brown University's "Intermedia," a hypermedia system developed for use in research and teaching. The author focuses on several interface features common across the various applications of Intermedia, such as style sheets and palettes for users and building blocks for programmers, and goes on to illustrate the operation of the system by describing a sample session. The text is supplemented by 15 figures and 19 references.**

Yim, Roger, and William Leigh. "A System for the Generation and Presentation of Online Documentation." Journal of Educational Technology Systems 17.3 (1989): 206-212.
Large Databases and Lab Data. **The article describes a system which converts text automatically into a form suitable for browsing and consultation online. The author explains the way the system is used to develop online documentation and tutorials and envisions the possibility of such an approach being applied within authoring systems to minimize the labor of courseware development.**

Zagari, M. " The Electric Cadaver." Journal of the American Medical Association 261.5 (1989): 781, 783.
Simulation vs. Authentic. **Noting that medicine, with its problems of information overload, has perhaps the greatest need for electronic information management methods of any field, the author describes the Electric Cadaver, a Stanford-developed video and computer-graphics atlas of the human body. The system, he argues, is not only useful in**

itself but is also a prototype for the integrated media projects that will play an increasingly vital role in information-intensive disciplines such as medicine.

Zhu, Zhi-Ting. "Biocode, an Environment for the Development of Bilingual Audio Courseware." Journal of Educational Technology Systems 16.1 (1987): 7-16.
Simulation vs. Authentic. The author describes the courseware development environment intended for Chinese authors which he has created for the Apple II, BICODE. It consists of the BICODE language, an execution program, and a utility package and features the functions of bilingual text presentation, speech output, and dynamic graphic display. BICODE has been used to develop tutorials in several subject areas; Chinese educators who have used this environment have, the author attests, found it an effective authoring aid.

Zviran, Moshe, and Richard Blow. "DMSS - A Computer-Based Diabetes Monitoring System." Journal of Medical Systems 13.5 (1989): 293-308.
Control Issues. This paper describes a computer-based decision support system for diabetes monitoring designed to be used by both a physician and a patient. The author-developers suggest that its advantages lie in its comprehensiveness and flexibility. The system is also appropriate for use as a teaching aid for a new diabetic and a management tool to reduce much of the administrative workload of the medical staff in diabetes clinics.

Selected Reviews of Instructional Software in Scholarly Journals, Arranged Alphabetically by Discipline

Biology, Evolution.
Software reviewed. EVOLVE: Simulation.
Murphy, P.J. A CAL-based Distance Education Project in Evolution: 1. Description of the Project. *Journal of Biological Education.* **18:1** (1984). 37-44. Author is affiliated with The Open University, UK.
Length of review. approx. 7+ pages, 2500 words.
Copyright held by Journal of Biological Education, Institute of Biology
20 Queensberry Pl., London SW7 2DZ

Biology, Evolution.
Software reviewed. EVOLVE: Simulation.
Hodgson, B.K. and P.J. Murphy. A CAL-based Distance Education Project in Evolution: 2. Evaluation of the CAL-based Project in Relation to Alternative Projects. *Journal of Biological Education.* **18:2** (1984). pp. 141-146. Author is affiliated with The Open University, UK.
Length of review. approx. 5+ pages, 3900 words.
Copyright held by Institute of Biology
20 Queensberry Place London, SW7 2DZ

Biology, Experimental.
Software reviewed. STELLA: Simulation.
Costanza, Robert. Simulation Modeling on the Mac using STELLA. *BioScience.* **37:2** (1987). 129-132. Author is affiliated with Louisiana State U.
Length of review. approx. 4 pages, 1160 words.
Copyright held by American Institute of Biological Sciences
730 11th St. N. W., Washington, D. C. 20001-4584

Biology, Genetics.
Software reviewed. Gntics prob prctc in Trbo Pscl: Tutorial.
Browning, Mark and James Lehman*. Identification of Student Misconceptions.... *Journal of Research in Science Teaching.* **25:9** (1988). 747-61. Author is affiliated with Purdue University.
Length of review. approx. 15 pages, 4500 words.
Copyright held by Nat'l. Ass'n. for Research in Science Teaching

Biology, Genetics.

Software reviewed. BMA, CON, COT, SEQ, CODEX: Simulations, tutorial.

Wood, Peter*. Use of Computer Simulations in Microbial and Molecular Genetics. *Journal of Biological Education.* **18:4** (1984). 309-12. Author is affiliated with Sunderland Polytechnic, UK.

Length of review. approx. 3.5 pages, 1600 words.

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Biology, Microbiology.

Software reviewed. CLASSIFY, BUG SIMULATOR: Analysis tool, simulation.

Soddell, J. A. and R. J. Seviour*. CLASSIFY: A Group Teaching Exerises in Microbial Identification and Numerical Taxonomy Using a Commodore 64 Microcomputer. *Journal of Biological Education.* **19:3** (1985). 232-236. Author is affiliated with Bendigo College, Australia.

Length of review. approx. 4+ pages, 2600 words.

Copyright held by Institute of Biology
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Chemistry, Chem calculations.

Software reviewed. MULTIPLAN: Spreadsheet.

Kauffman, Joel M. Chemistry Calculations Using MULTIPLAN and the Macintosh. *Journal of Computers in Mathematics and Science Teaching.* **6:3** (1987). 38-42. Author is affiliated with Philadelphia College of Pharmacy and Science.

Length of review. approx. 4+ pages, 2500 words.

Copyright held by JozCompin Math and Science Teaching
Box 60730 Phoenix, AZ 85082

Chemistry, Molecular chemistry.

Software reviewed. CAMSEQ/M,MOLGRAF,ALCHEMY,othrs: Simulation, analysis.

Sadek, Maruse and Sharon Munro. Comparative Review of Molecular Modeling Software for Personal Computers. *Journal of Computer-Aided Molecular Design.* **2:2** (1988). 81-90. Author is affiliated with Victoria College of Pharmacy, Australia.

Length of review. approx. 10 pages, 2700 words.

Copyright held by Maruse Sadek, Victoria College of Pharmacy
381 Royal Parade, Victoria, Australia 3052

Chemistry, Organic.

Software reviewed. CHEMBASE: Database.

Marshall, John C. Review of CHEMBASE. *J. Chem. Inf. Comput. Sci.* **27:1** (1987). 47-8. Author is affiliated with St. Olaf College, MN.

Length of review. approx. 2 pages, 1500 words.

Chemistry, Quant. analysis.

Software reviewed. Acid-Base Titrations: Analysis tool.
Cogdell, Thomas J. Acid-Base Titrations. *Journal of Chemical Education*. **65:2** (1988). 47. Author is affiliated with U. of Texas, Arlington.
Length of review. approx. 1 pages, 750 words.
Copyright held by American Chemical Society
20th & Northampton Sts., Easton, PA 18042

Economics, Statistics.

Software reviewed. Exercises based on Visicalc: Analysis tool.
Lamaison, H. J.*. Micro-Computer Software packages in Teaching Economics and Statistics. *International Journal of Math, Education, Science, and Technology*. **17:1** (1986). 67-9. Author is affiliated with Brunel University, UK.
Length of review. approx. 2.5 pages, 800 words.

Education, Advising students.

Software reviewed. GSA: Database.
Chan, Ding-Yu and Jeffrey K. Cochran. Using Expert-System Shells for Graduate Student Advising. *Engineering Education*. **78:5** (1988). 310-12. Author is affiliated with Arizona State U.
Length of review. approx. 2.5 pages, 800 words.
Copyright held by American Society of Engineering Education, Suite 200
11 Dupont Circle, Washington, D.C. 20036

Education, College.

Software reviewed. PLATO: Courseware, communications.
Bitzer, Donald L.* The Plato Project at the Univer. of Illinois. *Engineering Education*. **77:3** (1986). 175-180. Author is affiliated with U. of Illinois.
Length of review. approx. 6 pages, 2700 words.
Copyright held by American Society of Engineering Education
Suite 200, 11 Dupont Circle, Washington, D.C. 20036

Education, Teaching tools.

Software reviewed. TESTWORKS et. al.: Various test generators.
Vockell, Edward and Jane Hall. Computerized Test Construction. *The Social Studies*. **80:3** (1989). 114-121. Author is affiliated with Purdue U. .
Length of review. approx. 7+ pages, 3690 words.
Copyright held by Helen Dwight Reid Educational Foundation
400 Albermarle St. NW, Washington D.C. 20016

Engineering, College.

Software reviewed. Andrew: Workstation courseware.
Zabrowski, Susan*. Andrew: CMU's New Computing Environment. *Engineering Education*. **77:3** (1986). 161-166. Author is affiliated with Carnegie-Mellon U.
Length of review. approx. 6 pages, 2000 words.
Copyright held by American Society of Engineering Education
Suite 200, 11 Dupont Circle, Washington D.C. 20036

Engineering, Computer design.

Software reviewed. Finite Element Analysis Program: Analysis tool.
Bettess, Peter and Martin J. Downie*. Simple Finite Element Codes in OCCAM on a Transputer. *Engineering Computations: Int'l. Journal for C.-A. Eng. & Software* **6:1** (1989). 74-83. Author is affiliated with University of Newcastle-upon-Tyne, U. K.
Length of review. approx. 9.5 pages, 4700 words.
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54 Newton Road, Mumbles, Swansea SA3 4BQ UK

Engineering, Computer design.

Software reviewed. Innovation Lab: Simulation.
Cleaver, Thomas*. A Simulated Laboratory Experience in Digital Design. *Engineering Education*. **78:2** (1988). 128-30. Author is affiliated with U. of Louisville.
Length of review. approx. 3 pages, 2000 words.
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Washington D.C. 20036

Engineering, Electrical engineering.

Software reviewed. Robot Odyssey (modified): Simulation.
Cleaver, Thomas G.*. A Simulated Laboratory Experience in Digital Design. *Engineering Education*. (1988). 128-130. Author is affiliated with University of Louisville.
Length of review. approx. 3.0 pages.

Engineering, General.

Software reviewed. CAEN: Workstation courseware.
Atkins, D.E. and Leslie A. Olsen*. U. of Michigan's Computer-aided Engineering Network. *Engineering Education*. **77:3** (1986). 146-152. Author is affiliated with U. of Michigan.
Length of review. approx. 7 pages, 4700 words.
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Suite 200, 11 Dupont Circle, Washington, D.C. 20036

Engineering, Mechanical .

Software reviewed. Laboratory Course: Simulations, experiment guides.
Bau, Haim H.* Creating a New Undergraduate Engineering Laboratory Course. *Engineering Education.* **78:3** (1987). 180-184. Author is affiliated with U. of Pennsylvania.
Length of review. approx. 5 pages, 1740 words.
Copyright held by American Society for Engineering Education
Suite 200, 11 Dupont Circle, Washington D.C. 20036

Engineering, Statics.

Software reviewed. CAI statics lessons: Hypertext package.
Nelson, Clayton et. al.* CAI Applications in Statics. *Engineering Education.* **77:2** (1986). 96-100. Author is affiliated with Texas A &M U.
Length of review. approx. 5 pages, 2706 words.
Copyright held by American Society of Engineering Education
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English, Composition.

Software reviewed. Writer's Workbench: Analysis tool.
Garvey, James J. and David H. Lindstrom. Pros' Prose Meets Writer's Workbench: Analysis of Typical Models for First Year Writing Courses. *Computers and Composition.* **6:2** (1989). 81-97. Author is affiliated with Colorado State University.
Length of review. approx. 16.5 pages, 4248 words.
Copyright held by Michigan Technological University
Dep't. of Humanities, Hougton, MI 49931

English, Composition.

Software reviewed. PARNASSUS: Interactive revision tool.
Neuwith, Christine M. Intelligent Tutoring Systems: Exploring Issues in ... Teaching Writing. *Computers and the Humanities.* **23** (1989). 45-57. Author is affiliated with Carnegie-Mellon U.
Length of review. approx. 13 pages, 8600 words.
Copyright held by Kluwer Academic Publishing Group
P.O. Box 358, Accord Station, Hingham, MA 02018-0358

English, Composition.

Software reviewed. COMPOS-1: Prewriting tool.
Phillips, Gerald* and Bradley R. Elwein. Composition on the Computer: Simple Systems & Artificial Intelligence. *Communication Quarterly.* **36:4** (1988). 2413-61. Author is affiliated with Pennsylvania State U.
Length of review. approx. 18+ pages, 5500 words.
Copyright held by Eastern Communications Ass'n., Dept. of Speech and Montcalm State College, Upper Montclair, NJ 07043

English, Composition.
Software reviewed. Writer's Workbench: Textual analysis.
Smith, Charles and Kathleen E. Kiefer. Using the Writer's Workbench Programs at Colorado State Univ. *6th Internat'l. Conference on Computers & the Humanities, N.C. State U.* **(volume)** (1983). 672-84. *Volume edited by* Burton, Sarah K. & Douglas D. Short. Author is affiliated with Colorado State U.
Length of review. approx. 13 pages, 4000 words.
Copyright held by Computer Science Press, Inc.
11 Taft Court, Rockville, MD 20850

English, Composition.
Software reviewed. Writer's Workbench: Writing analysis tool.
Smith, Charles R. et. al.* Computers Come of Age in Writing Instruction. *Computers in the Humanities.* **18** (1984). 215-224.
Author is affiliated with Colorado State University.
Length of review. approx. 9+ pages, 5500 words.
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P. O. Box 1057 Osprey, FL 33559

English, Composition.
Software reviewed. HOMER, GRAMMATIK, STYLE: Analysis tools.
Smye, Randy. Style and Usage: Mentor Not Judge. *Computers and Composition.* **6:1** (1988). 47-61. Author is affiliated with Sheridan College, Ontario.
Length of review. approx. 15 pages, 3000 words.

English, Composition.
Software reviewed. Writer's Workbench: Textual analysis.
Van Pelt, William V. Another Approach to Using Writer's Workbench Programs. *6th Internat'l. Conference on Computers & the Humanities, N.C. State U.* **(volume)** (1983). 725-29. *Volume edited by* Burton, Sarah & Douglas D. Short. Author is affiliated with London House.
Length of review. approx. 5 pages, 3000 words.
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English, Composition.
Software reviewed. ESSAY WRITER: Prewriting tool.
Wresch, William*. Essay Writer: A Program to Help Students Through the Writing Process. *Collegiate Microcomputer.* **1:3** (1983). 281-85. Author is affiliated with U. of Wisconsin.
Length of review. approx. 5 pages, 2000 words.

English, Composition & literature.

Software reviewed. GRAMMAR, BLACKBOX, others: Drills, tutorials, simulations.
Schwartz, Helen. Monsters & Mentors: CAI for Humanistic Education. *College English*. **44:2** (1982). 141-152. Author is affiliated with Oakland University.
Length of review. approx. 11+ pages, 4200 words.

English, Composition (ESL).

Software reviewed. CUES: Prewriting tool.
Craven, Mary-Louise. Evaluating CUES: Some Problems and Issues in Experimental CALL Research. *Calico Journal*. **5:3** (1988). 51-64. Author is affiliated with York University, Toronto.
Length of review. approx. 13+ pages, 4500 words.
Copyright held by Calico Journal, Brigham Young U. Press
Provo, Utah 84602

English , Literature.

Software reviewed. SEEN,INVENT,others: Tutorial, prewriting tool.
Madden, Frank. Computer Software and the Introductory Literature Course. *College Literature*. **15** (1988). 1-8. Author is affiliated with Westchester Community College.
Length of review. approx. 7+ pages, 1800 words.

General, Writing.

Software reviewed. WordStar Professional 4.0: Word processor.
Oldsey, Bernard. Review of WordStar Professional 4.0. *College Literature*. **15** (1988). 101-106. Author is affiliated with .
Length of review. approx. 5+ pages, 1100 words.

General, Composition.

Software reviewed. Writer's Workbench: Composition & editing tool.
Raye, Carol L.* Writer's Workbench System: Heralding a Revolution in Textual Analysis. *6th Internat'l. Conf. on Computers & the Humanities, N.C. State Univ.* **(volume)** (1983). 569-72. *Volume edited by* Burton, Sarah K. & Douglas D. Short. Author is affiliated with Bell Laboratories.
Length of review. approx. 3.5 pages, 1600 words.
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General, Writing.
Software reviewed. Bibliography Generator: Bibliographic database.
Caras, Pauline. Review of Bibliography Generator. *College Literature*. **15** (1988). 107-110. Author is affiliated with Ass't. Ed., College Literature.
Length of review. approx. 3+ pages, 650 words.

General, Writing.
Software reviewed. Nota Bene 2.0: Word processor.
Myrsiades, Kostas. Review of Nota Bene. *College Literature*. **15** (1988). 85-92. Author is affiliated with West Chester University.
Length of review. approx. 7+ pages, 1900 words.

General, Writing.
Software reviewed. WordPerfect: Word processor.
Weiss, Michael. Review of WordPerfect. *College Literature*. **15** (1988). 93-100. Author is affiliated with .
Length of review. approx. 7+ pages, 1200 words.

Geology, Gen. apparatus.
Software reviewed. Template for Filevision: Simulation, tutorial.
Mayer, Larry. Teaching the Use of Geological Equipment with a Microcomputer. *Journal of Geological Education*. **35:4** (1987). 266-70. Author is affiliated with Miami University, Ohio.
Length of review. approx. 5 pages, 1800 words.
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1041 New Hampshire St., Lawrence, KS 66044

Geology, Hydrogeology.
Software reviewed. PUMPTEST.BAS: Analysis tool.
Smith, Stephen*. A Microcomputer Program for Evaluating Pumping Test Results for Confined Aquifiers . *Journal of Geological Education*. **34:3** (1986). 183-185. Author is affiliated with University of Kansas.
Length of review. approx. 2 + pages, 900 words.
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Geology, Petroleum.
Software reviewed. OILGAME: Game.
Nichols, John. A Computer-Assisted Oil Exploration and Production Game. *Journal of Geological Education*. **35:4** (1987). 217-21. Author is affiliated with U. of Liverpool.
Length of review. approx. 5 pages, 2400 words.
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1041 New Hampshire St., Lawrence, KS 66044

Geology, Seismology.
Software reviewed. Wave travel program: Analysis tool.
Sverdrup, Keith A. A Program for Calculating Refraction Times for Layered Models With Arbitrarily Dipping Discontinuities. *Journal of Geological Education*. **34:4** (1986). 262-4. Author is affiliated with U. of WI , Milwaukee.
Length of review. approx. 3 pages, 900 words.
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1041 New Hampshire St., Lawrence, KS 66044

Geology, Structual.
Software reviewed. Strain-Graph, Shear-Zone: Graphics.
McEachran, David and Stephen Marshak*. Teaching Strain Theory in Struct. Geology Using...Programs for the Macintosh Computer. *Journal of Geological Education*. **34:3** (1986). 191-5. Author is affiliated with U. of Illinois.
Length of review. approx. 4+ pages, 2700 words.
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1041 New Hampshire St., Lawrence, KS 66044

History, W. European history.
Software reviewed. CLIO: Tutorial.
Newton, Jeffrey and David S. Thomas*. The CLIO Project: A Program of CAI in the Western History Course. *The History Teacher*. **19:2** (1986). 181-199. Author is affiliated with Rhode Island College.
Length of review. approx. 17+ pages, 7800 words.

Language, Arabic.
Software reviewed. VERPS: Drills.
Levine, Arvin et. al.* VERPS: A Verb Exercise and Reference Program...for Arabic Language Instruction. *Univ. Level CAI at Stanford: 1968-1980*. **Stanford (volume)** (1981). 735-761. *Volume edited by* Suppes, Patrick. Author is affiliated with Stanford University.
Length of review. approx. 27 pages, 7000 words.
Copyright held by Inst. for Math. Studies in the Social Sciences
Stanford U., Stanford, CA 94305

Language, Danish, French.
Software reviewed. DANSK, others: Drills.
Allen, John R.* The Use of a Computer in Drilling. *Die Unterrichtspraxis*. **5:1** (1972). 31-35. Author is affiliated with Dartmouth.
Length of review. approx. 5 pages, 2400 words.

Language, French.
Software reviewed. ELSE: Drills.
Allen, John R.* ELSE at Dartmouth: An Experiment in CAI in French. *The French Review*. **44:5** (1971). 902-912. Author is affiliated with Dartmouth.
Length of review. approx. 10+ pages, 3800 words.
Copyright held by American Ass'n. of Teachers of French
57 E. Armory, Champaign, IL 61820

Language, French.
Software reviewed. exercises in PLATO: drill.
Ariew, Robert* . Teaching French on PLATO IV. *System*. **2:1** (1974). 1-7. Author is affiliated with University of Illinois.
Length of review. approx. 6.5 pages.
Copyright held by Pergamon Press

Language, French.
Software reviewed. Rationalist direct method: Drill.
Barson, John et. al.* University Level CAI in French. *University Level CAI at Stanford: 1968-1980*. **Stanford (volume)** (1981). 685-705. *Volume edited by* Suppes, Patrick. Author is affiliated with Stanford U.
Length of review. approx. 21 pages, 8500 words.
Copyright held by Inst. for Math. Studies in the Social Sciences
Stanford Univ., Stanford, CA 94305

Language, French.
Software reviewed. Word Attack Plus: Drills.
Becker, James E. Review of "Word Attack Plus". *The French Review*. **62:5** (1989). 912-13. Author is affiliated with U. of Northern Iowa.
Length of review. approx. 1+ pages, 540 words.
Copyright held by Amercan Assoc. of Teachers of French
57 E. Armory, Champaign, IL 61820

Language, French.
Software reviewed. French tenses program: Drills.
Collett, John *. A Tenses Computer Program for Students of French. *Modern Language Journal*. **66:2** (1982). 170-179. Author is affiliated with U. of Waikato, Hamilton, New Zealand.
Length of review. approx. 10 pages, 4500 words.
Copyright held by National Federation of Modern Language Teachers
U. of Wisconsin Press, 114 Murray St., Madison, WI 53715

Language, French.

Software reviewed. (CAI based on SuperPilot): Language drills.
Fischer, Robert A.* Computer-Assisted Instruction in the French Classroom: A Pilot Project. *The French Review*. **61:4** (1988) Author is affiliated with Southwestern Texas State U.
Length of review. approx. 8 pages, 3360 words.
Copyright held by American Ass'n. of Teachers of French
57 E. Armory, Champaign, IL. 61820

Language, French.

Software reviewed. Face à face: Drills.
Hirsch, Bette G. Face à face. *Modern Language Journal*. **72:2** (1988). 249-250. Author is affiliated with Cabrillo College.
Length of review. approx. 1.5 pages, 672 words.
Copyright held by National Federation of Modern Language Teachers
U. of Wisconsin Press, 114 N. Murray St., Madison, WI 53715

Language, French.

Software reviewed. FRELEM: Drill.
Hope, Geoffrey*. Elementary French CAI. *Foreign Language Annals*. **15:5** (1982). 347-53. Author is affiliated with U. of Iowa.
Length of review. approx. 7 pages, 2600 words.
Copyright held by American Council on the Teaching of Foreign Language, 2 Park Ave., New York,NY 10016

Language, French.

Software reviewed. On pratique le français: Drills.
Klemme, William. Review of "On pratique le français". *Modern Language Journal*. **73:1** (1989). 98-99. Author is affiliated with U. of Hawaii.
Length of review. approx. 1+ pages, 675 words.
Copyright held by Modern Language Journal, U. of Wisconsin Press
114 N. Murray St., Madison, WI 53715

Language, French.

Software reviewed. FRAND: Drill.
McEwen, Nelly*. CAI in Second-Language Teaching. *Canadian Modern Language Review*. **33:3** (1977). 333-43. Author is affiliated with U. of Alberta.
Length of review. approx. 9.5 pages, 3000 words.

Language, French.

Software reviewed. On pratique le français: Drills.
Pederson, Kathleen Marshall . Review of "On pratique le français". *The French Review*. **62:4** (1989). 708-9. Author is affiliated with Wheaton College.
Length of review. approx. 1 pages, 520 words.
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57 E. Armory, Champaign, IL 61820

Language, French.
Software reviewed. Système-D: Word processor.
Pederson, Kathleen Marshall. Review of Système-D. *The French Review*. **62:5** (1989). 91. Author is affiliated with Wheaton College.
Length of review. approx. 2.5 pages, 1164 words.
Copyright held by American Ass'n. of Teachers of French
57 E. Armory, Champaign, IL 61820

Language, French.
Software reviewed. ZAP: Syntactic operations tutorial.
Decker, Henry W.* CAI Instruction in French Syntax. *Modern Language Journal*. **10:5-6** (1976). 263-7. Author is affiliated with U. of California, Riverside.
Length of review. approx. 4.5 pages, 1950 words.
Copyright held by Nat'l. Federation of Modern Lang. Teachers.
U. of Wisconsin Press, 114 N. Murray St., Madison, WI 53715

Language, French and Spanish.
Software reviewed. Misfits; Match Us; Opposites: Drill.
Klemme, William H. French Word Games and Spanish Word Games. *Modern Language Journal*. **72** (1988). 250-251. Author is affiliated with Indiana University.
Length of review. approx. 2 pages.
Copyright held by National Federation of Modern Language Teachers
U. of Wisconsin Press, 114 Murray St., Madison, WI 53715

Language, German.
Software reviewed. German word games: Drills.
Balser, Jeffrey and Sylvis Blice*. Computer Games for the German Class. *Die Unterrichtspraxis*. **11:2** (1978). 95-96. Author is affiliated with Harrison High School, Evanston, IL.
Length of review. approx. 2 pages, 500 words.

Language, German.
Software reviewed. German word games: Drills.
Mullen, Inga. German Word Games. *Modern Language Journal*. **72:4** (1988). 490-491. Author is affiliated with Kent State U., Stark.
Length of review. approx. 1+ pages, 600 words.
Copyright held by Modern Language Journal, U. of Wisconsin Press
114 N. Murray St. , Madison, WI 53715

Language, German.
Software reviewed. PILOT-SPAN: Game.
Sanders, Ruth. PILOT-SPAN: A Computer Game for German Students. *Die Unterrichtspraxis*. **17:1** (1984). 123-9. Author is affiliated with Miami U.
Length of review. approx. 6+ pages, 2500 words.

Language, Greek literature.

Software reviewed. TLG: Database and interfaces.
Helgerson, Linda W. CD-ROM and Scholarly Research in the Humanities. *Computers and the Humanities.* **22** (1988). 111-116. Author is affiliated with Pres., Diversified Data Resources, Inc.
Length of review. approx. 4.5 pages, 3000 words.
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Language, Latin.

Software reviewed. Verb Factory: Tutorial game.
Culley, Gerald R.* CAI and Latin: Beyond Flashcards. *The Classical World.* **72:7** (1979). 393-401. Author is affiliated with University of Delaware.
Length of review. approx. 8.5 pages, 2900 words.
Copyright held by The Classical Ass'n. of the Atlantic States
Dept. of Classics, Duquesne University, Pittsburgh, PA 15219

Language, Latin, Greek.

Software reviewed. Various: Overview of current software.
Culley, Gerald R. CAI in Classics: An Assessment. *The Classical Bulletin.* **65** (1989). 17-31. Author is affiliated with U. of Delaware.
Length of review. approx. 15.5 pages, 7056 words.
Copyright held by The Classical Bulletin
7020 N. Western Ave., Chicago, IL 60645-3416

Language, Russian.

Software reviewed. Various: Drills.
Baker, Robert L. CAI: An Overview...with Particular Reference to Russian. *Slavic and East European Journal.* **28:4** (1984). 511-20. Author is affiliated with Middlebury College.
Length of review. approx. 9+ pages, 3840 words.
Copyright held by American Ass'n. of Teachers of Slavic & E. European Languages, Dept. of Slavic Languages, SUNY Albany, Albany, NY 12222

Language, Spanish.

Software reviewed. Spanish videodiscs: interface to videodisc.
Schneider, Edward W. and Junius L. Benni. Veni, Vidi, Vici Via Videodisc: A Simulator for Instructional Conversations. *System.* **2:1** (1983). 41-46. Authors affiliated with Syracuse University and Brigham Young University.
Length of review. approx. 7 pages.
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Language, Spanish.

Software reviewed. s2400: drill.
Smith, Philip D.* s2400, A Computer Assisted instructional Review of Basic Spanish Grammar. *System.* **4:3** (1976). 182-90. Author is affiliated with West Chester (PA) State College.
Length of review. approx. 9 pages.
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Mathematics, (gen. higher mathematics).

Software reviewed. MathCAD 2.0: calculations tool.
McKeough, William J. MathCAD 2.0. *Mathematics and Computer Education.* **22:2** (1989). 142. Author is affiliated with Hofstra University.
Length of review. approx. .8 pages.
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Mathematics, (gen. higher mathematics).

Software reviewed. GrFx: function plotter.
McKeough, William J. GrFx. *Mathematics and Computer Education.* **22:2** (1988). 143-144. Author is affiliated with Hofstra University, NY.
Length of review. approx. 1.5 pages.
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Mathematics, Algebra.

Software reviewed. Algebra Drill and Practice III: drill.
Barnett, Jeffrey C. Algebra Drill and Practice III. *Mathematics and Computer Education.* **22:2** (1988). 149. Author is affiliated with Fort Hays (KS) State University.
Length of review. approx. 1 page.
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Mathematics, Algebra.

Software reviewed. Algebra Drill and Practice II: drill.
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